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PRIZE ESSAY, 1898.

MOTTO: "Non tibi, sed omnibus."

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ESPRIT DE CORPS.—A TRACT FOR THE TIMES.

BY CAPTAIN CASPAR FREDERICK GOODRICH, U. S. N.

A careful search through the Proceedings of the Naval Institute reveals the singular and instructive fact that they contain no consideration of, if indeed any allusion to, the subject of this essay. Papers and discussions, abstracts from service and technical journals, hints and suggestions abound which touch upon or completely elucidate a multitude of topics incident to the profession. They range over the entire field of naval thought, and they form, taken together, an enduring monument to the wisdom of the founders of the Institute, as well as to the capacity and devotion of those who have guided its destinies since its formation. Without these precious volumes no naval library is to-day complete. The student may learn from them substantially all there is to know, in theory at least, about administration, types of ships, their armament and protection, their speed and coal endur-

ance, the details of their equipment, their use singly or in concert, the best method of educating officers and men, how to care for the latter in sickness and in health, etc., etc.; but of the necessity and means of cultivating that solidarity of sentiment which alone can put the breath of life into the ship or the fleet, considered as integers, never a word is spoken. The subject of a naval *morale* is not implicitly assumed; on the contrary, its very existence is either forgotten or deliberately ignored. A stranger to the service, who should seek diligently to acquaint himself with the essentials of naval practice, would rise from the conscientious study of these Proceedings without so much as a suspicion that there ever existed a body of unwritten law and traditions more potent than statutes and regulations in welding into a consistent whole the somewhat incongruous elements that go to form an organized navy. Yet every member of the profession knows, almost intuitively, that his relations to his associates, whether senior or junior, are governed by a rigid code peculiar to the Navy and dating back to time immemorial. It is a truism which, like many other truisms, it is well to revive and to repeat on occasion, that ships, however formidable in themselves, are measured in value by the resultant force of those on board. When officers and men act in harmony the result is happiness and efficiency. Where dissensions arise, and unity of effort gives place to the disrupting tendencies of opposing or selfish interests, the effect is at once manifest in a diminution of the fighting worth of the vessel or of the fleet.

In the Navy, *esprit de corps* is "the blest tie that binds." The essayist has thought that an inquiry into the reasons why *esprit de corps* has received so little attention from naval writers, an investigation into its nature and obligations, and a consideration of the consequences that attend its non-observance as well as of the profits that accrue from following its dictates, might be both timely and beneficial.

I.

The overwhelming necessity which has obtained, until a recent period, of rehabilitating our marine is conceded without dispute. To such a low ebb had our fleet fallen that the combined exertions and individual activities of all officers were imperatively demanded that we might build ships with the utmost practicable

speed and equip them with every device essential to the proper performance of their functions. We had reached a point when the very life of the Navy seemed at stake. Not to progress was to die. To the herculean task of reconstruction every person in the service brought his best energies and a zeal, an industry and an ability beyond praise. What seemed almost impossible at the outset was found entirely feasible, and to-day the work is largely accomplished. The writer is unwilling to yield first place in hearty recognition of both the end itself and the instruments by which it was achieved. But an apprehension has arisen that, in so entirely giving itself up to the material needs of the moment, the Navy may have insensibly drifted from its former standards of professional faith until the fact and need of a naval *morale* stand in danger of being overlooked. It would, perhaps, be inexact to assert that this apprehension has grown into certainty, but the vicious development of this vicious tendency is at times but too marked not to call for the serious attention of such of us as have given their best years and their best thought to the service, as well as of those who, coming after, must receive the sacred flame from our hands and in turn transmit it bright and pure to *their* successors. Is it not, indeed, time to acknowledge frankly to ourselves that, like the Israelites of old, we have wandered away to strange gods and that we must revert to the ancient and true worship, lest we perish?

In the absorption occasioned by the building up of our naval edifice afresh from its very foundations, a reason may be found for our failure to cultivate the less obtrusive virtues of loyalty and self-abnegation, which, if not altogether sufficient, may yet be urged in excuse with much apparent justice.

Another powerful cause of the present regrettable condition of affairs lies in the distressingly impeded flow of promotion which, condemning bright and capable officers to spend the greater part of their lives in subordinate positions, blights their energies and produces that most pitiable discontent, bordering on despair, which discerns no rift in the clouds, no prospect of near or distant relief. The prize of youthful ambition has ceased to attract, or, when gained, the palate is too jaded by long waiting to appreciate or enjoy it. Like apples of Sodom it turns to ashes in the mouth. It would seem idle to quote Goethe to these unfortunates,

"Entbehren sollst du, sollst entbehren."

Even if the Navy List continues to remain unduly congested in places, the obligation still holds to bear our fate like men, striving to win better things, yet ready and willing to sacrifice our individual wishes and our personal comfort, working early and late, through doubt and discouragement, for that paramount object, the good of the service.

A third and hardly less potent occasion for this waning of *esprit de corps*, unless it may be conceived as standing rather in the relation of effect than cause, is the undue and wholly unprofessional exaltation of service on shore over service afloat. Time was when the goal of an officer's ambition lay in the commendable performance of duty on board ship. In the junior grades, to be considered a capable watch officer or navigator or executive or, later, to command a vessel or a fleet with ability and distinction, was deemed a sufficient recompense for toil and study, the ample crown of long years or a lifetime of sustained effort. The brilliant career of to-day, however, is measured but too often by the number of important and desirable positions occupied when *not* at sea.

Some apology for this erroneous and distorted view might have been brought forward when our ships were obsolete in type —the laughing-stock of the maritime world—and, in truth, it was during that period that sea-going was least in favor. A better spirit is now beginning to prevail, and the fact that sea duty is our chief concern to be generally admitted; but it is difficult to overcome the evil results of a false standard so long tacitly, if not openly, acknowledged; or to forget that it was not many years since officers were threatened with orders to sea as a punishment. We are, unhappily, still familiar with rather recent instances of officers who have deliberately elected service on shore in preference to service afloat, even at the loss of professional standing. Such cases should be to us as warnings rather than examples.

The long period of uninterrupted peace which the nation has enjoyed since the Rebellion, and for which as patriotic Americans we should be and are profoundly thankful, has exerted a powerful influence on service opinion, through the lack of opportunities for the display of personal prowess and professional skill in the operations of war. The ambitions of individuals have, perforce, sought their outlet in enterprises more in consonance with the

prevailing sentiment of the hour. Denied, unfortunately as naval officers however fortunately as citizens, the chance for honor and advancement offered by hostilities, we have turned our activities into other channels and have found their scope in the more immediate, yet vastly less important matters of design and construction, and particularly in the administration of affairs, the chief, if not the only, means to-day of achieving distinction. No laurels adorn the brow of the faithful and capable sea officer. He has but the reward of an approving conscience, and he counts himself fortunate if he escapes condemnation for some trifling dereliction or for some assumed error of judgment. He has but done his duty.

Since the routine of ordinary cruising rarely if ever presents occasion for the manifesting of the larger capacities, he who would be reckoned something more than his fellows must, it would appear, look outside and beyond his ship. Be not deceived; the reputation of no naval officer can be considered enviable or exemplary which is not based upon an excellent record at sea. Lacking this condition, brilliant appointments on shore are but as sounding brass and a tinkling cymbal, as evanescent as the noise produced by this scriptural orchestra. The essayist looks confidently to the time, and that in the near future, when the so-called prizes in the gift of the Navy will be reserved for those who have well discharged their duties as sea officers, and when a large credit in the column of the Navy Register entitled "sea service" will be regarded as a token of departmental approval. A general desire to go to sea will be followed by as general a determination to make the ship all of which she is capable in good order, efficiency and discipline; and by the re-adoption of *esprit de corps* as the sole instrumentality by which this end can be reached.

If further proof were needed of the comparatively low esteem in which sea-going has been held, it would be found in the fact that in years not long past the reward of the highest standing at the Naval Academy, an institution founded for the sole purpose of training naval officers, was assignment to a corps which has nothing whatever to do with the handling of ships and men. Such an exaggeration of the importance of the tool itself over that of the man who uses it is difficult to explain.

"Historically," says Mahan, "good men with poor ships are

better than poor men with good ships; over and over again the French Revolution taught this lesson, which our own age, with its rage for the last new thing in material improvement, has largely dropped out of memory." *

While due allowance should be made for personal taste, many able men possessing a marked and insuperable bent for mechanical pursuits, it is unjust to the service and to the individual to encourage the notion that the human element is, or ever can be, subordinate in naval affairs to the machinery by which that element is aided in its labors, and through which it may make or mar the destinies of the nation. It has been truly said, "The ship is measured in its value by the value of the man who commands it." To pass voluntarily into a non-military corps therefore was a tacit acknowledgment on the part of the graduate of the Naval Academy that, while especially gifted in certain admirable mental attributes, he was deficient in those more sturdy qualities which characterize the successful naval officer, or else that he valued the larger salary of the constructor above the wider opportunities for power, distinction and usefulness afforded by a naval career.

In view of the hearty, earnest and, let us hope, successful efforts now making to remove by wise legislation some of the unnecessary and wholly unpleasing differences to be found in the naval service, it has become possible, at the very last moment of writing, to suggest what previously discretion and a regard for the susceptibilities of others would have barred out of the essayist's treatment of this question. Even sentiment requires something tangible for its sustenance, something real to which to cling. May not one reason for the rather lax condition of *esprit de corps* be found in the fact that pay has been greater and promotion more rapid in certain of the non-military branches of the Navy? In this sordid age when men measure things and, alas! other men, by their money value, their financial equivalent, the captain of a ship has not infrequently been less well paid than a junior under his command. Has this been seemly in itself or calculated to increase his self-respect? Men are but human after all. While they need not be unduly rewarded for the performance of duty, however onerous, still the latter should not be rendered irksome

* Mahan, Rev. and Emp. I, 103.

through receiving less practical recompense than that of a subordinate whose functions are not in the least military and whose responsibilities are, comparatively speaking, insignificant. The military duties of the profession ought to be first and foremost. It is for them that the Navy exists. The *morale* of the service must necessarily be unfavorably affected by every distorted appreciation of the importance of non-combatant performance.

The causes briefly alluded to, with others less obvious which it is bootless to investigate, have combined to produce a faulty conception of the service as a whole and a notable diminution of the force and recognition of that sound and healthy *esprit de corps* which it is our duty singly and collectively to foster and to encourage. No more pressing call exists to-day. None are too old to turn again to the true cult, none too young to grasp its essentials and to devote themselves earnestly and faithfully to its exercise. It is the soul of the Navy, and ours, from the junior cadet to the senior admiral, the charge to "save that soul alive."

II.

Living as we do at the close of the nineteenth century, and perceiving on every hand the signs of a complete revolution in the ideas which govern the relations of individuals to the State and to each other; watching the growth of new political doctrines which seek to reduce all members of society to one plane of dreary and uniform equality irrespective of innate capacity or external condition; recognizing the impatience with which the few remaining marks of differentiation between man and man are regarded, and the steady loss of influence on the part of that class of citizens who on account of their birth, education and moral elevation would, in the ideal community, be entrusted with the largest measure of the powers of government, we are unconsciously affected by the medium in which we live, and are likely, if unresisting, to be borne along by the swift current of general unrest towards the rocks upon which will be shattered the little that is left of respect for authority and reverence for our elders. It is not my purpose to discuss or even question the soundness of this new sociological development as touching the world at large, but as to its effect upon the organization to which we belong there can be but one opinion. Our only safe guide is experience. The history of the French navy under the Directory is conclusive on

this point.* Whatever be the conditions that hold in civil life, the precedents of generations of naval officers must, in the main, be our rule in the present and for the future. These precedents may, with propriety, be traced back to and in the British navy from which we drew our early laws and usages. The *physical* continuity is confessedly interrupted, for our navy was not formed, as naturalists say, by fission—the dividing of a parent stem and the splitting off of one or more complete vital units—but the *moral* continuity is unbroken.

What was the fundamental motive that governed England's naval leaders? The answer is not far to seek. Loyalty to the Crown.

It is impossible to read such of the writings of England's great sailors as have been transmitted to the present day without observing the frequent recurrence of expressions that breathe this sentiment. While these phrases may occasionally be a form of speech as common and unmeaning as the "Your obedient servant" at the end of a letter, which is but now disappearing from correspondence, they are often encountered in such connections that they can only be interpreted as involuntary outbursts of genuine feeling. Thus Drake, in submitting "A Relation of the Rare Occurrences &c" to Queen Elizabeth, speaks of it as "a worke to him no less troublesome, yet made pleasant and sweete, in that it hath bin, is, and shall be, four your Ma^ts^ content, to whom I have devoted myslefe, live or die."† The courtier in Drake never overshadowed the venturesome hard-fighting sailor to whom God's truth and the air of a bloody combat seemed equally essential conditions of a Christian life.

The same devotion is to be seen in his letter to Walsingham announcing his departure for Cadiz. "The wynd commands me away, our shipe is under sayell, God graunt we may so live in his feare, as the enemy may have cawse to say that God doth fight for her Majestie as well abrod as at home, and geve her long and happye lyfe, and ever victory agaynst God's enemyes and her Majesties."‡ It is difficult to rightly apportion the various ingredients in this quaint prayer—ambition, love of fighting, and loyalty—yet that all three are to be found therein cannot be denied.

*See Mahan, Sea Power in the French Revolution and Empire, vol. I, chap. II. †Barrow's Drake, p. 38. ‡Barrow's Drake, p. 221.

When Sir Edward (afterwards Lord) Hawke was given the thanks of the House of Commons for his splendid action at Quiberon he replied, "In doing my utmost, I only did the duty I owed to my King and my country, which ever has been, and shall be, my greatest ambition to perform faithfully and honestly to the best of my ability."

With us, as Americans, it is love of country which should supply the place of a feudal or monarchical loyalty and furnish an incentive to brave deeds and patient suffering. That the object of the new devotion is less worthy than that of the old no one can fairly claim. For a sovereign, possibly lacking in all the attributes of kingship save the sceptre and royal purple, we may substitute our native land, the seat of our joys and sorrows, the mistress whom we stand ready to serve through good and evil fortune, in prosperity and calamity. As a distinguished officer happily expresses it, "The bed-rock of a naval service is organization; its soul, honor; its demand, courage; its inspiration, love of country." *

If we be willing to offer up our lives for our native land unquestioningly and as dutiful sons, surely we ought not to begrudge those daily sacrifices and minor offices which, distasteful as they may be, are the *sine qua non* of true discipline and an efficient organization. †

This general rule of conduct will be admitted by officers without exception as admirable and exact. It is a truism which none can deny, and to the inert it appears so delightfully vague as to involve no possible risk to comfort and peace of mind. Without question then we all agree to it. But if we do, what follows then? Does it carry no mandate that shall control our actions? Such a moral principle once accepted *must* impose conditions that we are powerless to evade. A little reflection will show that, far from being a transcendental speculation of no real effect, it is or should be a living force influencing every official thought and deed. It commands us to be diligent in making ourselves useful servants through painstaking study of all that relates to the

* Rear-Admiral Belknap, U. S. N., in "Some Aspects of Naval Administration in War, with its Attendant Belongings in Peace."

† The Secretary of the Navy says, "There are men who would count their lives as nothing beside their country's need, yet pull apart 'like a balky team' in the homely adjustments of ordinary work."

moment of pursuit, and their destruction would have been equally complete no matter where encountered. Not the least of Nelson's qualities as a great captain was this faculty of arousing enthusiasm for the common good—a readiness to do and to suffer. In his hands *esprit de corps* was a potent instrument to move men's souls and to elevate even the baser of his confreres to the highest plane of professional honor.

The essayist suggests that no better definition of *esprit de corps* can be found than in the sympathetic reading of this famous despatch. We cannot all be Nelsons, but we can and must be a band of brothers.

III.

It is not a pleasant task to hold the mirror up to nature and to reveal to their owner the blemishes which mar the countenance; still less is it agreeable to acknowledge our own faults and weaknesses; but a frank recognition of our shortcomings must precede, indeed it is the first step towards, their correction.

To run over the gamut of official error is, however, neither necessary nor desirable. A few instances that may be described in general terms will abundantly suffice for the purpose in view. The essayist has thought it inexpedient to state his case in full, and, on the other hand, he has not felt at liberty to assume that its proof will be conceded without question in the forum of service public opinion. In thus attempting to avoid Charybdis without falling upon Scylla, he has ventured to rely upon a friendly sympathy with his motive, which is to aid the profession in remedying its faults and yet not to paint those faults in needlessly sombre or alarming colors. He would indeed greatly deplore the application of any remark of his, designed avowedly to describe but an exception, to the establishment of a general rule. The majority of the *personnel* in our own Navy is animated by right sentiments in the main. Of the minority, again, the larger portion is readily amenable to influences that make for good. While the essayist is justly proud of the profession of which he is a humble member, he cannot blind himself to the fact that some improvement still remains possible before it reaches that high plane of thought and feeling of which it is abundantly capable. A little of specific exposition of its needs appears therefore desirable and pardonable.

We are all but too familiar with a type of officer which is the inevitable product of a systematic, if unwitting, attempt to substitute narrowly defined regulations for the broad and comprehensive operations of *esprit de corps* and service traditions. Many there be who study the letter of these printed ordinances; but for one who seeks in them enlightenment as to his duties and responsibilities, others will be found who look only for a statement of their rights and privileges. Such officers, in short, devote the time spent over them more especially to ascertaining rather what others may *not* do than what they *should* do, and they arise from their investigations better equipped for blocking than for facilitating the work which all must execute.

It is not meant to imply that the safeguards with which the regulations surround the exercise of authority, in the interest and for the protection of the subordinate, are to be disregarded. On the contrary, they are wise and salutary, for the superior is not always exempt from the failings of human nature; but they can be made harmful if the dominant fact be overlooked that they need only be appealed to when an evident disposition is manifested to forget that while great power is given to the superior there is attached to this great power the obligation to use it for the good of the service and not to the prejudice of the individual.

The officer of the type developed through this one-sided study of our book of regulations sets up to be an oracle on such matters; he announces that he will not obey such and such orders if given, he is a focus of incipient mutiny, a thorn in the side of his superior, a nuisance to his messmates, and he is seldom, if ever, a good officer.

This is no new doctrine. Fifty years ago Captain Liardet wrote in his admirable "Professional Recollections," "Those who cavil most at the orders of their superiors while they themselves are in a subordinate situation, are almost invariably the most tenacious and overbearing to others when in command themselves. The heart and soul of all good naval discipline is strict obedience to orders; and when any officer habitually deviates from this principle, whatever his rank or abilities may be, he cannot be considered of any value to the public service. To insure the *morale* of the Navy, officers are now called upon more than ever to be scrupulously careful in their conduct; as captains

and senior lieutenants, in the present day, have quite enough to do to uphold the discipline of their ships, without having to contend with insubordination from those who are expressly appointed by the Admiralty to assist in carrying out all things for the good of the service with energy and zeal." The officer under study devotes so much time and thought to the pastime of preparing a pitfall for his seniors that he has little or none left in which to learn the duties of the position he occupies on board. Fault is found with some minor negligence on his part, the regulations are invoked as a shield, and friction arises. He is rarely capable of separating his official and personal relations, so that a rebuke almost invariably turns him into an enemy watching with the eye of a hawk for the first mistake committed that shall furnish the occasion for a report to a common superior.

Instances again are stated to have occurred where one officer profited by another's shortcomings to himself break the rules of the service, in conscious security against charges that could be met by counter-charges of equal or greater severity. To hold over an erring brother the threat of publishing his frailties or his derelictions is an offense only possible on the part of an officer lacking in the elementary notions of *esprit de corps*. He is disloyal to his messmate in thus whetting his knife for a covert thrust, and he is disloyal to his profession in condoning an offense which, in his judgment, would, if known, be visited with severe punishment and which, therefore, must be of serious nature.

It is of course difficult to lay down a hard and fast rule of conduct in such cases, for *esprit de corps* has two phases, the major reflecting the service as a whole, the minor touching the relations between individuals. If each officer were constantly on the alert to report every infraction of the regulations on the part of others, life on board ship would be intolerable. A generous sympathy is obligatory on all, but when the safety of the ship is imperiled, or when her good name is jeopardized by wanton action or notoriously scandalous behavior, the offender forfeits his claim to consideration and he must be sacrificed, regretfully if you please, but none the less inexorably, to the necessity of maintaining the general reputation for high aims and clean living. There can be no doubt as to what to do when the question assumes the definite form of choosing between

the individual or the service, yet we can all adduce instances wherein an undesirable or even a disreputable person has been persistently screened by his shipmates under a faulty conception of *esprit de corps*.

Certain ships in the Navy have enjoyed the unenviable reputation of being "unhappy."* It is believed that in nearly every such case the fault lies with the officers themselves. Instead of devoting their energies to making the vessel efficient, each in his own way and branch, they have sought to undermine the central authority, and have even gone to the forbidden length of sitting in open judgment on their seniors. The essayist is the last person in the world to seek to deprive his colleagues of that blessed privilege of growling which is dear to the hearts of all that go down to the sea in ships. There are indeed some kinds of growling which furnish harmless relief, like a prompt safety valve, or which produce amusement and a healthy intellectual competition after the most delicately imaginative figures of descriptive speech. These are permissible, if not actually necessary and salutary. But personal growling against the superior, for example, and sarcasm and dispraise, are under the ban. These are dangerous and they must be eliminated. How much better is it to recognize the necessity at the outset and refrain from contracting habits that bring us questionable pleasure, no benefit, and certain trouble.

As a matter of fact, the general happiness of a ship depends less upon the temper and whims of the captain than is generally supposed. Vastly more important in this connection are the good fellowship of the officers themselves and the character, strength and tact of the executive. Blessed is the ship where the first lieutenant is strong and courteous, able and considerate. He fosters that sentiment of loyalty to the ship, the captain and the admiral, without which the cruise would be dreary indeed, and he sets an example which influences the professional life and development of every youngster on board. With such an executive it matters little for the atmosphere of the vessel what may be the captain's idiosyncrasies. The coming generation of officers can find no better diversion than in planning how they shall shape their professional growth in order to command,

* A stronger phrase is not uncommon.

when executive, the respect of their equals and juniors and the entire confidence of their commander.

There is, by the way, no method devised by Satan so infallibly certain to destroy the happiness of a ship, so contrary to the dictates of *esprit de corps*, as the open discussion of superiors. Servants have been the reporters of such conversations since Noah's time, carrying their accounts forward to the ship's company, where nothing is lost in the telling, with a regularity and a zeal which could well be devoted to better employment. Nor is this the only harm done. Such criticisms produce loss of respect for the seniors, and a readiness to take umbrage, which exert a baneful effect on the tone of the entire vessel. They are without justification in themselves and they offend against *esprit de corps*. No ship has ever been happy or efficient where they are tolerated. Lord Collingwood is said to have written, "All mutinies are started at the ward-room table."

Says Captain Griffiths in his work on Naval Economy, "But that officers should sit down in the presence and hearing of their servants, sentinels, etc., and use disrespectful language against their superiors (particularly their captains) must at once appear so self-evidently improper, so subversive of all discipline, so calculated to provoke insubordination and mutiny, that it would be idle to dwell on the subject." *

The essayist begs to be understood as showing by his quotations from foreign writers that our own Navy has by no means the monopoly of the defects mentioned. Moreover, from personal experience, we are all aware that other services are similarly affected. The reason may be deep-seated in the nature of the seafaring man. None the less would it be gratifying if the Navy of the United States could claim the role of exemplar in this matter of naval *morale*. To this end a solemn sense of duty should impel us. Nor is the end remote or difficult of attainment. We have but to will it and the prize shall lie in our hands. This is no figure of speech. Our case has already been passed upon in the highest court and judgment pronounced upon us by a keen yet kindly critic.

Says the Secretary of the Navy in his Annual Report to the President for the year 1897:

* Quoted, with approval, in Liardet's Professional Recollections, p. 288.

It is a pleasure to report to you the high character and fine sense of duty, the professional attainments, and patriotic spirit of the great body of officers of the line and staff of the Navy and Marine Corps. The whole impulse, from their entrance into the service at the Naval Academy, is to develop not only efficiency in the performance of duty, but variety and breadth of ability and culture. They have the liberal education of extended foreign travel. Their employment necessitates the study not only of international and commercial relations, but also of modern scientific forces and their application to the practical demands of a great department of the national life.

Naval service is not limited to the sailing of a ship and the firing of a gun. A modern man-of-war is a compendium of industrial inventions and appliances; a business and manufacturing plant as well as a fighting machine. A large part of its crew is engaged in skilled labor—the running of engines and the movement of machinery. An officer's duties, and the demands upon his professional resources, whether in the movement of ships or in the work of the mechanical departments connected with their make and repair, involve problems of construction, the use of the dynamic forces of air, water, steam and electricity, and the nice adjustment of batteries, guns and gear of enormous tonnage, yet moved on hair lines and by a touch of the finger.

All this calls for advanced requirements on the part alike of those who command and direct, and of those who construct and operate. The responsibility that attaches to the captain of a single battle-ship, or to the admiral who commands a fleet, necessitates the greatest resources of skill, prudence, discretion and education. To these demands the Navy rises. Whether serving on shipboard, or in the important work of instructing our naval youth, or studying war problems, its officers in every line of the naval establishment deserve the public confidence.

There are, of course, sporadic cases of demerit. There is now and then an officer guilty of excessive use of intoxicating liquors, a fault which is simply unpardonable, in view of his responsibility for life and property and of the importance of his example to the men under his command, and which I know you are determined to punish with unrelenting severity. There is the occasional shirk, the seeker for soft place, the nerve-worn hesitant, the petty despot. There are cases, happily rare, of pecuniary dishonesty or untrustworthiness. It is the function of the examining boards to weed out all these elements and prevent their promotion.

There are also, sometimes, petty frictions and jealousies which make one long for the high mind. There is too often an inclination on the part of some officers, when a new question or exigency arises, to consider with aggressive and sometimes petulant zeal its bearing upon their special position, or command, or corps or bureau, or station, lest they lose or somebody else get a thin slice of authority or jurisdiction, whereas their always first and paramount impulse should be the best interests of the whole service—a text that ought to hang on every eyelid in the Navy. There are men who would count their lives as nothing beside their

which have justly won for their author the admiration of all privileged to listen to his periods glowing with life and truth, "The impression we cast upon those that pass within our shadow they carry on forever. The very words they speak have immortality. . . .

"And our immediate influence! This touch of life upon life: how wonderful it is! Something of character always goes with it. If the blacksmith puts some indefinable quality of himself into the iron he shapes, if the printed page in order to reach its highest artistic perfection must come from the direct touch of the printer's hand upon the press, how much more do human souls take from us impressions of character? And that which fixes the impression, that which *is* the impression, is character. The trade, the art, the profession, being learned, that which more than anything else does the work is character. Character is in the carpenter's strokes upon the nail, it is in the sailor's pull upon the rope, it is in the officer's orders upon the deck; it commands the ship, it paints the picture, it delivers the oration, it writes the book; it is the finest quality of gifts and of life. . . .

"All we do must live on. Evil deeds must have a wicked immortality. . . .

"But the cheering thought is that whatever is good in us shall likewise have tenacity of being. The moralities and virtues of our lives, the generous acts, the good dispositions that have marked them, . . . must all live as seeds in the world. Not seeds garnered and locked up in the inclosure of single lives; but seeds scattered abroad, that become in their fruitfulness the blessing of all." *

This reflection brings home to all of us the sense of a grave responsibility. Through our example, if not through our precepts, we are unconsciously instrumental in shaping the careers of those around us. We may stand for good or we may stand for evil. That we should stand for nothing is forbidden us. Whether we will or no, we are apostles of, or apostates from, *esprit de corps*. It becomes our charge, then, "to show in ourselves a good example of virtue, honor, patriotism and subordination," as our naval bible phrases it, and to indicate to others the path that leads to professional usefulness and honor.

* From a sermon delivered at the Naval Academy, by Chaplain Henry H. Clark, U. S. Navy.

The theme is not a new one. Our great Farragut illustrated it in every act of his life, as the midshipman ten years old and as the admiral of nearly seventy. A more painstaking student of his calling never existed. His fund of varied information was astonishingly extended, but whatever he learned was with the sole view to increasing his value as a naval officer. Other ambition he had none. His extreme modesty restrained him from pouring out his soul, even in his diary or intimate correspondence, as did Lord Nelson, his only rival in our esteem, so that we are unable to quote his own words in proof of his motives and must find the mainsprings of his deeds in the deeds themselves. "The moral of Farragut's life," says his biographer, "is that success is never an accident; that the surest way to become great is by rising to the top of one's profession, thoroughly mastering the duties of each grade as it is reached. To such a man, fame, if it comes, is but an episode; his mind is fixed solely upon the full development of his powers and effective performance of his appropriate work." It would almost seem as if Farragut had shaped his course by that admirable code laid down by Collingwood to a protégé in a letter which all young officers should commit to memory. "A strict and unwearied attention to your duty," said he, "and a complaisant and respectful behavior, not only to your superiors, but to everybody, will ensure you their regard. . . . Guard carefully against letting discontent appear in you; it is sorrow to your friends and triumph to your competitors, and cannot be productive of any good. Conduct yourself so as to deserve the best that can come to you. . . . Let it be your ambition to be foremost on all duty. Do not be a nice observer of turns, but forever present yourself ready for everything; and if your officers are not very inattentive men they will not allow the others to impose more duty on you than they should; but I never knew one who was exact not to do more than his share of duty, who would not neglect that when he could do so without fear of punishment. . . . Remember, Lane, before you are five and twenty you must establish a character that will serve you all your life."

Of another he wrote, "If he takes no more pains in his profession than he has done he will not be qualified for a lieutenant in sixteen years, and I should be very sorry to put the safety of a ship and the lives of men into such hands. He is of no more

use to us here as an officer than Bounce * is, and not near so entertaining. . . . He is living on the navy, and not serving in it." Let us hope that this last remark is applicable to few, if any, of our number.

Commodore Morris writes of himself: "By great perseverance I acquired the ability to read French with facility, and then used works in that language to read history and study naval tactics and other subjects connected with the higher branches of my profession." Morris's careful devotion to the acquisition of nautical knowledge saved to our navy its most famous frigate, for it was by his suggestion that the Constitution, of which he was the first lieutenant, was warped out of gunshot from the chasing British squadron in 1812. He ascribes the subsequent victory over the Guerriere to "the unwearied exertions of our officers to devise and bring into daily exercise every important improvement which might increase the chances of success against a navy, to which we might soon be opposed as an enemy, and upon which there were so many injuries and insults to be avenged for the honor of our country. This expectation and feeling were of general, almost of universal prevalence among our officers, and led them to a unity of purpose and action which could not fail of producing important results. Their number was so small that each knew almost every other, and there was scarcely a feeling of unworthy jealousy, though much of generous emulation, among those of corresponding ranks." It was Nelson's "band of brothers" again, but conservatively expressed as became Morris's more self-contained and less expansive nature.

It is impossible to read the lives of the great sailor captains of our own as well as of foreign navies without being profoundly impressed with the fact that their laurels were won only through the seizure of the happy opportunity for which their whole previous career had been one long preparation, in careful study and practice of their profession and in cultivating that loyalty to the service and to each other which alone could make their study productive.

It was the contemplation of Farragut's character which led Admiral Belknap † to write: "Ah! that is the sort of men we want Annapolis . . . to turn out. A man who knows his own mind, has the courage of his convictions, believes in himself,

* His dog. † Op. cit. sup.

and in the loyalty, devotion and intrepidity of the officers and men he commands under any circumstances of peace or war. An officer whom to know is to love, whose subordinates, in their great trust and supreme devotion, will follow to the death."

The essayist suggests to his brother officers that among the many benefits that will flow from a revival of the ancient cult is an improvement in their material conditions.

As a body, we labor under many unnecessary disadvantages and hardships from which we ought to be relieved, that the maximum efficiency of the fleet may be attained. Pay and promotion, for example, are legitimate subjects upon which to urge remedial legislation. While, as suggested by Mr. Secretary Long, something is possible through rigid examinations that, by weeding out the unworthy, shall at the same time benefit the capable and faithful, the limit in that direction is soon reached. A reasonable petition for help out of our troubles would then be in order, and, coming from the entire naval organization as a unit, it could not fail of its purpose. One need not be a prophet nor the son of a prophet to assert that there will be no marked change in existing naval law under these heads until the Navy speaks as with one voice.*

If the essayist has seemed unduly strenuous in claiming importance for the efficiency of a naval *morale*, it is because, in this materialistic age, the transcendental and less obvious condition is overlooked, and the underlying motives and the indispensable medium of mutual confidence, in which these motives work to the desired end, are unacknowledged, if not unperceived. Just as in all human actions there are the body, the mind which guides and the soul which animates—so in naval affairs there is the ship herself, her drills and discipline, with the education and training of her officers and men as the means by which the ship is controlled and directed, but it is *esprit de corps* which furnishes the breath of life. If we keep this fact before our eyes, realizing that as a man is measured by his desires and aspirations, so, in a ship, her general tone is the index of her efficiency, we cannot fail to practice and to preach the doctrine which it has been the intention of this paper to expound.

We shall surely have our reward. It may be in the correction

* This was written nearly a year ago.

of some of the many irregularities and anomalies which bear upon us hardly at times, and for whose adjustment mutual confidence and a readiness to sink self for the good of all are prerequisite. This much, at least, is certain, no relief to the body of officers and no general improvement of the service as a whole can be obtained so long as individual interests are fostered at the expense of the Navy at large, and so long as *esprit de corps* is regarded as of antiquarian or transcendental interest rather than recognized and proclaimed as a living and compelling force, the only bond by which to unite all the members of the naval profession, whatever be their rank or corps, in a homogeneous body of faithful, loyal and patriotic servants.

And doing this we shall likewise gain the right to use the stirring words of Nelson when asked by Lord Barham to select his own officers: "Choose yourself, my lord; the same spirit actuates the whole profession; you cannot choose wrong."

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE DEVELOPMENT OF SMOKELESS POWDER.

By Lieutenant John B. Bernadou, U. S. N.

[*Continued from No. 83.*]

It was stated in the preceding paper that the ballistic effect produced by a progressive explosive depended directly upon the volume of gas it evolved upon combustion, but was not directly dependent upon the attainment of complete combustion. Assuming total conversion from solids into gases and non-liability to detonation, pyro-cellulose was shown to be the form of nitro-cellulose best adapted for conversion into smokeless powder. As this material contains only enough oxygen to convert its carbon into carbonic oxide, CO—less than gun-cotton, which converts its carbon partly into carbonic acid gas, CO_2, and partly into carbonic oxide, CO—the attainment of maximum efficiency from nitro-cellulose was thus shown to be accomplished through a reduction from a maximum to a mean in the amount of oxygen capable of being incorporated into nitro-cellulose.

On the other hand, it was stated that the incorporation of certain amounts of oxygen carriers (nitro-substitution compounds other than nitro-celluloses, such as nitro-glycerine and nitrates of metallic bases) into colloid nitro-cellulose led to the attainment of an increase in initial velocity of projectile for a given developed bore pressure. As nitro-glycerine furnishes a surplus of free oxygen to aid in completing the combustion of the gases from the nitro-cellulose, while the nitrates surrender oxygen on application of heat, it would appear in this case that the attainment of a more complete combustion led to improvement in ballistic effect.

Upon firing series of rounds of the several powders from a given gun we obtain the following results as to their manner of explosive action:

1. Strips of over a certain mean thickness will be only partly consumed in the bore; the unconsumed remnants will be projected burning from the gun, to be quenched in the cool outer air, where they fall unconsumed to the ground and may be picked up at various distances from the piece in front of the muzzle, possessing the original form (in reduced dimensions) of the grains of which the charge was originally composed. Such powders develop low bore pressures and afford low muzzle velocities. In point of work performed they are equivalent to smaller charges of quicker powders. It may be remarked that no work is done in raising the temperature of the unconsumed portions of the grains, for if the temperature of the latter be raised but a few degrees, the ignition point of the explosive is reached and its substance would wholly disappear.

2. Strips of under a certain mean thickness are totally consumed in the gun. They develop high pressures for low velocities. The thinner the strips the less the weight of charge required to develop the limiting permissible pressure, on account of the greater initial surface presented by the thinner strips, which occasions a high initial gas development.

3. A certain mean thickness of strip will be found, for which, at a set limit of pressure, a minimum weight of powder will develop the greatest velocity that can be developed at that pressure. If strips of other thicknesses develop practically identical velocities and pressures for the same pressure limits, it will be by

the same moment; and a, γ and μ, constants depending upon the form of the grain.

If the grain be a rectangular parallelopiped with a square base, and the altitude as the least dimension, we have

$$a = 1 + 2x, \qquad \lambda = \frac{2x + x^2}{1 + 2x}, \qquad \mu = \frac{x^2}{1 + 2x},$$

where x is the ratio of the altitude to the side of the base."

Applying the above to the present case we find that if the altitude be considerably diminished (x approaches zero) we have the case of the thin plate; and that the constants approach the values

$$a = 1, \qquad \lambda = 0, \qquad \mu = 0,$$

or $\phi(\gamma) = \gamma$.

But γ depends alone on the thickness of the plate, therefore the speed of combustion of a plate is a linear function of its least dimension.

burning greater weights of powder. Such a powder may be designated a maximum powder, for the material from which it is prepared and for the gun from which it is fired.

Suppose, then, that colloided gun-cotton of nitration N = 13.3 develops in a given gun a maximum value $V/P = \frac{2100}{15}$, what will be the effect of incorporating into such powder a certain amount of nitro-glycerine, or of metallic nitrates such as barium and potassium nitrates? Assume that during the process of colloiding the requisite amount of nitrates be uniformly incorporated throughout the substance of the pasty mass, which is subsequently formed into strips, as before. For this material we shall find that the maximum powder develops a value of $V/P = \frac{2400}{15}$, as against $\frac{2100}{15}$ for the pure colloid, a gain in velocity of 300 ft. sec. for a given pressure; in energy, $\left(\frac{mv^2}{2g}\right)$, of about 30 per cent.

If, in lieu of nitrates, we incorporate nitro-glycerine into the colloid, we will obtain a pasty mass that can be worked conveniently into the form of rods or cords, whence the name Cordite, applied to one of its best known types. Cordite, as used in England, consists of

Nitro-glycerine	58 parts.
Gun-cotton	37 parts.
Vaseline	5 parts.

Such a powder, fired under the above conditions, develops a value of $V/P = \frac{2400}{15}$ approx.

There is one characteristic of powders containing nitrates such as the K and the French BN, to which attention is to be directed. The nitrates contained in these powders exist in them in a state of suspension; in an undissolved state. For the BN the microscope reveals minute crystalline particles uniformly disseminated throughout its mass; the barium nitrate employed in the K powder is insoluble in the colloiding agent, acetone, and is also insoluble in the colloid, in which it is held in a state of suspension and of uniform distribution.

In the case of the nitro-glycerine powders it is known that the nitro-cellulose is not in true solution in the nitro-glycerine. In this connection the following quotation from an authority upon nitro-glycerine powders, Mr. Hudson Maxim, may be cited:

"In the very early smokeless powders, especially those made of compounds of soluble pyroxylin (gun-cotton) and nitro-gly-

cerine, it was supposed that the nitro-glycerine actually held and retained the pyroxylin in solution, but it has since been learned that the nitro-glycerine is held by smokeless powders, whether made from high or from low grade gun-cottons, in much the same manner as water is held by a sponge; in fact, the pyroxylin exists in smokeless powders in the shape of a very minute spongy substance, and the nitro-glycerine is held in a free state within the pores of this sponge."

"It is possible even with powders containing as little as 25 per cent. of nitro-glycerine, to squeeze out the nitro-glycerine in a pure state by subjecting a piece of this powder to great pressure between smooth steel plates."

The amount of nitro-carrier (nitrate or nitro-substitution compound other than nitro-cellulose) considered necessary to the production of good ballistic results, as exemplified in certain known powders, may be tabulated as follows:

TABLE III.

Variety of powder.	Nitro-carrier used.	Per cent. of nitro-carrier in given weight of powder.
Cordite.	Nitro-glycerine.	58
Maxim.	Nitro-glycerine.	10 to 25
BN.	Barium and potassium nitrate.	21 to 25
K.	Barium nitrate.	14.25

The composition and ballistic properties of the three classes of explosives—pure colloids, colloids containing metallic nitrates, and colloids containing nitro-glycerine—may be compared as follows:

TABLE IV.

Variety.	Pure colloid.	K.	BN.	Cordite.
	Gun-cotton, 85.00	Gun cotton and soluble nitro-cellulose, balanced 84.25	Insol. nitro-cellulose, 38.67	Nitro-glycerine, 58
	Soluble nitro-cellulose, 10.00		Soluble nitro-cellulose, 33.23	Gun-cotton, 37
	Sodium carb. 1.00		Barium nitrate, 18.74	Vaseline, 5
	Solvent, resins, &c. 4.00	Barium nitrate, 14.25	Potassium nitrate, 4.54	100
	100.00	Calc. carb. 1.50	Cal. carb. 3.65	
		100.00	Volatile, 1.29	
			100.12	

TABLE IV.—*Continued.*

Type.	Pure colloid.	Metallic nitrate.	Metallic nitrate.	Nitro-glycerine.
Manner of incorporation of oxygen carrier.		Solid undissolved particles, uniformly distributed throughout colloid matrix.	Solid undissolved particles, uniformly distributed throughout colloid matrix.	Undissolved particles held in suspension as water in sponge.
$\frac{V}{P}$	$\frac{2100}{15\text{-}19}$	$\frac{2400}{15}$	$\frac{2400}{15}$	$\frac{2400}{15}$

Remembering what has been said in relation to the ballistic performance of the varieties of powders cited, we are led to the following conclusion:

That minute particles of an oxygen carrier uniformly incorporated into a nitro-colloid and held in suspension in an undissolved state throughout the body of the same, render more progressive the combustion of the nitro-colloid into which they are incorporated.

For convenience of reference I shall refer hereafter to the oxygen carrier held in suspension in the colloid as the *accelerator*.

Viewed in the light of the principle here enunciated, the several powders that we have been considering are all similar variants of the pure colloid. The remark of the compounder, "that a little nitro-glycerine certainly does help the powder along," is now the more readily comprehensible.

The methods commonly employed for co-ordinating natural species may be applied, by way of illustration, to the classification of the various types of progressive explosives, to establish their relations to one another, and to indicate the lines along which advances have been effected.

TABLE V.

Family.	PROGRESSIVE EXPLOSIVES.									
Genus.	Agglomerated Powders.		Pure colloids.				Accelerated colloids.			
Species.	Blk. gunpowder.	Brown powder.	Acetone colloids (experimental; for small arms).	Pyro-cellulose. United States, Russia, France.	Acetic ether colloid. Wetteren.	Ether-alcohol, with or without insoluble nitro-celluloses incorporated.	Acetone colloid; nitro-glycerine accelerator. Cordite, Ballistite, Maxim.	Acetone colloid of blended nitro-celluloses; barium nitrate accelerator. K.	Ether-alcohol colloid; barium nitrate and potassium nitrate accelerator. BN. France.	Gun-cotton colloided with nitro-benzols. MN Rifleite.
Sub-species.	Various mixtures of charcoal, saltpetre and sulphur.	Various mixtures of charcoal, (partly charred and containing oxygen), saltpetre and sulphur.	Colloids of insoluble and soluble nitro-celluloses.	Poudre B: France.*	Gun-cotton, with or without soluble nitro-cellulose.	From nitro-cellulose. / From nitro-hydro-celluloses.	Various proportions of nitro-glycerine in nitro-celluloses.	Various proportions of nitro-celluloses and nitrates.	Various proportions of nitro-celluloses and nitrates.	*Rifleite;* nitro-cellulose colloided in acetone, with or without di-nitro-benzol. Gun-cotton colloided with mono-nitro-benzol.
Classification letter.	A.	B.	C.	D.	E.	F.	G.	H.	I.	J.

* The first rational smokeless powder; developed in France by the eminent savant M. Vieille.

We shall next consider how the accelerator acts to develop increased velocity without developing increased pressure.

1. It has already been shown how it is possible with powders containing as little as 25 per cent. of nitro-glycerine to squeeze out the nitro-glycerine in a pure state by subjecting the powder to great pressure between smooth steel plates.

If it be possible to extract nitro-glycerine by application of pressure from powder in which it is incorporated, then there will be a tendency to flow in the direction of least pressure from the instant of ignition of a charge to that of its complete combustion. This would mean, first, flow from within outwards in the gun chamber, where a relatively large proportion of the nitro-glycerine would be consumed; second, flow in the direction of the windage, where the amount of nitro-glycerine consumed would also be relatively great. Such action accounts for the rapid erosion of the surfaces of gun chamber and rifled bore when powders containing nitro-glycerine are employed.

2. The eminent Russian chemist, Professor D. Mendeléef, developer of smokeless powder in Russia, in a paper upon pyro-cellulose powder, says:

"The chemical homogeneity of pyro-collodion plays an important part in its combustion, for there are many reasons for believing that upon the combustion of those physically but not chemically homogeneous materials, such as nitro-glycerine powder (ballastite, cordite, etc.), the nitro-glycerine is decomposed first, and the nitro-cellulose subsequently in a different layer of the powder. The experiments of Messrs. T. M. and P. M. Tcheltsov at the Scientific and Technical Laboratory show that for a given density of loading the composition of the gases evolved by nitro-glycerine powders varies according to the surface area of the grains (thickness of strip), a phenomenon not to be observed in the combustion of the pyro-cellulose powders. There is only one explanation for this, viz., that the nitro-glycerine, which possesses the higher rate of combustion (Berthelot), is decomposed sooner than the nitro-cellulose dissolved in it. This is the reason why nitro-glycerine powders destroy the inner surfaces of gun chambers with such rapidity."

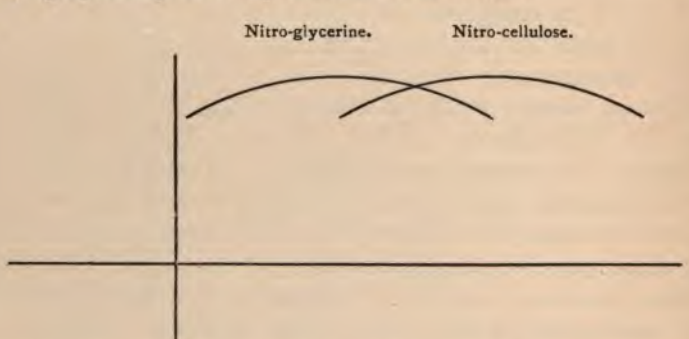
We conclude from the above that the nitro-glycerine incorporated into a colloid burns more rapidly than the nitro-cellulose forming the colloid. More nitro-glycerine is consumed with

one part of the charge than with another. During the first period the products of combustion evolved in chamber and bore are largely those of nitro-glycerine; during the second, those of nitro-cellulose.

Moreover, as both materials exist in an uncombined state, although in one of intimate admixture; as both decompose wholly into gases, while each contains sufficient energy to continue its own decomposition, once that decomposition is begun, there is no reason why the rates of the two decompositions should be equal; it would rather appear that each substance should decompose at the rate peculiar to itself, as far as it was able, under existing conditions of heat and pressure, to effect a separation of its substance from the mixed mass of the powder.

Conditions point, therefore, to there being two intervals in the decomposition of the charge, during one of which a maximum amount of nitro-glycerine, and, during another, a maximum amount of nitro-cellulose is burning.

In what follows it is not intended to attempt more than to indicate mode of progressive combustion as implying the superimposition of maxima and minima of effort. This may be represented graphically in the present case as follows:



The result of the combination of the conditions here indicated would be the imparting of a double impulse to the projectiles due to the successive occurrence of two maxima of acceleration. Considered as to their limit of possible range, the successive impulses may occur incrementally, so that the accelerator may be expressed in the form

$$\varphi(p')\frac{d^2p'}{dt^2}+\varphi(p'')\frac{d^2p''}{dt^2},$$

where p' represents the pressure due at any instant to the combustion of the nitro-glycerine; p'', that due to the nitro-cellulose.

The projectile may be regarded as receiving a third impulse, resulting from the chemical combination of the gases evolved by the nitro-glycerine and the nitro-cellulose. According to the researches of Messrs. Macnab and Ristori (Proc. Royal Soc., vol. LVI, p. 8), the decomposition products of nitro-glycerine are

CO_2	CO	CH_4	O	H	N	H_2O
57.6	—	—	2.7	—	18.8	20.7

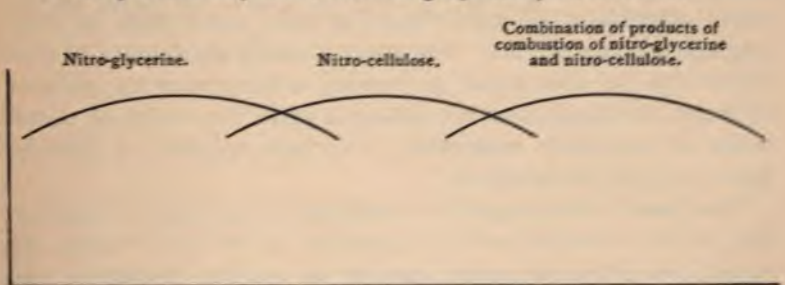
And from the same source we obtain the decomposition products of nitro-cellulose (N = 13.3) as

CO_2	CO	CH_4	O	H	N	H_2O
29.27	38.52	0.24	—	0.86	13.6	16.3

What may be called the third impulse would represent the combination at a high temperature of multiples of decomposition products developed in the ratios

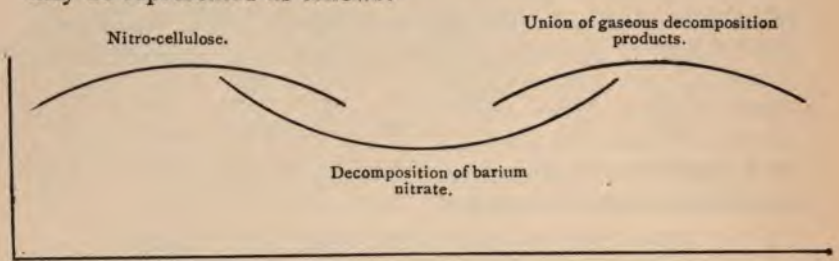
	CO_2	CO	CH_4	O	H	N	H_2O
A	57.6	—	—	2.7	—	18.8	20.7
B	29.27	38.52	0.24	—	0.86	13.6	16.3

These phases may be indicated graphically as follows:



Accelerated colloids of K and BN types containing metallic nitrates are next to be considered. We may assume that the nitro-colloid into which minute particles of a nitro-carrier of this type are cemented itself burns in approximation to the law of decomposition of the colloid. This state of affairs is similar to, though not identical with, the preceding; in the former, both nitro-glycerine and nitro-cellulose are able to effect their own decom-

position, evolving gases that recombine; in the latter, the nitro-cellulose alone possesses this property, the metallic nitrates surrendering their oxygen through the effect of heat developed during decomposition of the colloid. The successive reactions may be represented as follows:



Instead of three maxima of effort there are two maxima and one minimum, the maxima representing the combustion of the nitro-cellulose and the subsequent combination of the gases therefrom with the oxygen of the barium nitrate; the minimum, the absorption of heat expended in decomposition of the barium nitrate.

A comparison of the diagrams shows that the processes of combustion in the case of colloids containing nitro-glycerine and of those containing metallic nitrates are similar. Both represent aggregates of work resulting from successions of independent decompositions. For such powders an element of time enters into our conception of chemical action; what the ultimate products of combustion are depends upon the order of occurrence of successive evolutions of various volumes of different gases at high temperatures.*

The base of the projectile is subjected to a series of impulses due to the development of successive waves of pressure; the result is an increased initial velocity for a given developed pressure, the acceleration being sustained throughout a comparatively longer period of time.

Those familiar with experimental development of ordnance during recent years remember a type of multi-charge gun whose construction seemed based upon a favorable combination of correct principles, but which was rejected on trial, as its practical

* See extracts from paper by Prof. Mendeléef, p. 33.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HONORABLE MENTION, 1898.

MOTTO: What boots it at one gate to make defense,
And at another to let in the foe?—*Milton*.

OUR NAVAL POWER.

By Lieutenant-Commander RICHARD WAINWRIGHT, U. S. Navy.

THE USES OF A NAVY IN TIME OF WAR.

The naval force of a country engaged in war will act either on the offensive or defensive, but in both cases its objective will be the fleet of the enemy. A portion of the force may be acting offensively against the enemy while another portion remains to defend the coast. The stronger force will generally seek the enemy's fleet near his coast, while the weaker force will remain near home ports, so as to utilize the advantages of short lines of communications, repair shops, supply depots and coast fortifications.

The stronger force will endeavor to obtain "command of the sea," and after that, utilize this command by invading the enemy's country, blockading his ports and destroying his mercantile marine, endeavoring to bring the war to a successful ending by seizing his territory and destroying his commerce; while the weaker fleet will dispute the "command of the sea," and will endeavor, by taking advantage of the mistakes or misfortunes of the enemy, to defeat him and, if possible, to turn the tables upon him and seize the "command of the sea" with all its attendant advantages.

[illegible] sea power," not only [illegible] all its interest beyond [illegible] uncivilized. countries have [illegible] the world. No country [illegible] without adequate sea power [illegible] a large merchant marine [illegible] or in foreign bottoms will [illegible] unless aided by its own [illegible] navy.

[illegible] STATES BECAUSE OF [illegible] SITUATION.

[illegible] in a state of "pre- [illegible]" by those who [illegible] that the surest way [illegible] comers, they then [illegible] believe to be a [illegible] will dare attack [illegible] then point to [illegible] wars. With- [illegible] and what im- [illegible] we succeeded. [illegible] be necessary [illegible] is a great [illegible] wealth and [illegible] sea power [illegible]

also one that its immense resources are a protection in themselves. When did a policeman or a police force serve to create lawlessness? Would a court be effective without its officers to enforce its mandates? The idea of arbitration is undoubtedly one suitable to civilized nations and would serve to diminish the risks of war between mutually respecting countries; but there must be mutual respect backed by a reasonable show of power to enforce respect, the policeman must carry his club, until political and personal morals have progressed far beyond their present condition. Great Britain meant well with her arbitration treaty, but she did not offer to cede Bermuda to the United States.

The geographical position of the United States is one that plainly indicates the necessity of efficient armed forces to protect its extended frontiers, so long as political morality requires strength to protect wealth. North and south its frontiers are partly land and partly water, but on both the east and the west they are water.

Invasion by land can be resisted only by land forces. Invasion by sea may be resisted partially by land forces; but it is an imperfect and expensive way, and an invasion by sea should be met by sea forces. Moreover, in all countries bordering on the water, their borders are extended into the sea in proportion to their commercial interests, and these sea rights and interests can be protected only by sea forces.

At the present time our land frontiers are bordered by states comparatively weak in military strength, and it would be madness for them to attempt invasion while our small army is maintained at its present strength and efficiency. Of course, to disband or to materially reduce our army would be to invite border raids, if not to permit serious invasion.

Our eastern frontier is open to the attack of the great navies of the world; so is our western, only to a less degree, as it is more distant from their permanent bases. The first question to consider is, how far into the sea do our interests extend? At the present time we have a large foreign and coastwise trade, with a very small amount of tonnage engaged in the foreign trade and a very large tonnage engaged in the coastwise trade. Our interests at present do not demand protection far from our shores, and our citizens only require protection abroad when in

uncivilized countries. If our coast trade routes were well protected and our seaports kept free for ingress and egress, our interests beyond our shore would be well guarded. Still our interests have extended and our vessels have navigated to all parts of the world, and will do so again if our country continues to grow in prosperity and power. Then the trade routes must be protected and our commerce rendered secure along the line as well as at both extremities.

All history shows that great states do not remain long at a standstill. There is a rise and a fall among the great nations in their struggle for existence, more or less regular and constantly moving in one direction or the other. Our country must expand in its growth, extend its interests and continue to rise, or it will contract, diminish its interests and commence to fall from its great height. The struggle for existence in nations, like that in individuals, is ceaseless, vigorous and relentless. The law of the survival of the fittest is as true for the political aggregation as for the individual. Much has been written on the decline, in fact almost complete annihilation, of our merchant marine engaged in the foreign carrying trade. Before the war our vessels engaged in the foreign carrying trade were numerous. The effect of the war was to greatly diminish their numbers. Vessels destroyed by privateers, vessels whitewashed, hoisting another flag, and vessels laid up because those of other nations had seized their lines of trade, formed together by far the larger portion of our merchant marine. At this time came the change from sails to steam as a motive power, and from wood to iron and steel as a material for hulls. We were prevented by the war from keeping abreast of the improvements, and the conclusion of the war found us behind in the race. Our navigation laws were such as to discourage capitalists from going into the foreign trade under our own flag. But the most potent factor of all was the change in the condition of the internal communications that took place about the end of the war. Before the war, rivers and canals formed the principal routes for moving internal commerce; but after the war an impetus was given to railroad construction. Then both capital and labor found ample scope in developing the internal sources of wealth of the country, and better returns were promised than could be obtained by developing our foreign commerce and carrying trade.

Formerly the internal development was confined to a comparatively small strip of the country, and following natural laws, capital sought larger returns by developing foreign commerce; but with the spread of the railroads capital found ample employment in the development of internal commerce, and room was found for large quantities of foreign wealth, and our foreign trade moved along slowly, our foreign carrying trade ceased to exist. But there are signs showing that the quick returns and big profits reaped by capital in internal development are no longer easily obtained. There is still ample room for small profits due to steady development, but the speculative mind must turn once more to the increase of our foreign trade. We are now passing through a period of financial depression, and many nostrums are offered as sure cures to the public. Some would have free silver, others would withdraw the greenbacks, and others would have a higher tariff. In the meantime there is plenty of money ready to invest, but there is lack of confidence in the investments offered. Whether or no confidence returns with the passage of the tariff bill, when it does return, money will begin to find its way into foreign commerce, for it is certain that our farms and factories produce more than we can consume or export without new markets, and the glutted markets have reacted on each other. With new markets for our manufactures, the operators can afford to consume more products of the farm, and with new markets for the farm produce, the farmers can afford to use more manufactured articles. So that new markets are the road to wealth, and we must seek new markets in our own merchant vessels.

We must begin to seek our share in the new parts of China that are now about to be thrown open to the world, as is foreshadowed by the opening of West River in the south and the calling for bids for many tons of steel rails in the north. We must strengthen our trade with Japan, we must seek for a market in all portions of the globe; but above all we must develop our commerce with Mexico, Central and South America. Then we must have our own ships, for the competition in the commercial world is excessive, and the best markets go with the carrying trade. Once again our flag will be flown in all portions of the world, the protection of the navy must be extended far beyond our shore, and we must have command of

the Caribbean Sea. To other nations it may be as the Mediterranean is to Europe, but to us it must be as the Irish Sea is to Great Britain.

The policy of our country is not an aggressive one, we only require armed forces for the protection of our country and its interests. At present the protection of our coastwise commerce and the sea-coast is all we are called upon to undertake; but with our extended coast-line this is a large, if necessary, undertaking. To insure its safety against the strongest maritime power, Great Britain, will be to insure it against any probable combination of other powers. The most complete security is obtained by being sufficiently powerful to carry the attack to the coasts of the enemy; but with the immense sea forces of Great Britain such a measure of protection would strain the resources of our country, would tend to disturb our peaceful policy, and is certainly beyond the views of our most enlightened legislators, and therefore impossible of realization. Even with our present weak army, embryo navy and defenseless ports, there are many who assert we have nothing to fear from foreign nations. Not only do they prevent advance or increase, but they deprecate even expenditures necessary to maintain the little that we have in a reasonable state of efficiency. Yet there are some few who realize that we are a great nation, whose interests and affairs are so closely interwoven with those of other nations as to preclude us from remaining isolated in the political world, however anxious we may be to avoid the responsibilities attaching to our international position. There are a few who realize that while our resources are immense, we are unprepared for war, unprepared to assume the responsibilities forced upon us by our greatness. Some few who realize that millions of men unarmed are no better than a flock of sheep; undrilled, no better than a mob; and that a great and wealthy nation unprotected is but a temptation to others well prepared, and when that nation becomes aggressive in its attitude the temptation becomes irresistible.

Some few would see our country prepared for war as the best means to insure peace; and should war come, to insure against the evil results consequent upon a want of preparation. Some few, who would fortify our ports, strengthen our army sufficiently to man the fortifications without depleting the mobile force; and

above all, would build up our navy, without which fortifications and armies would be powerless to protect our coast. Some few, very few, would even recognize the necessity of accepting coaling stations dominating our coasts and ready to fall into our hands.

Many see the advantages of the Nicaragua Canal, but while recognizing the commercial gain, fail to see the greatly increased political responsibilities. The gains are well worth the risk, but unless the dangers are properly met the gains will prove illusive.

Few there are whose bosoms failed to swell with pride at the re-announcement, by the last administration, of the great American policy sometime called the Monroe Doctrine—an old policy somewhat enlarged to fit new conditions and new responsibilities, but still the true American doctrine of America for Americans—a doctrine recognizing that the strong United States is responsible for the protection of the weaker American states; that its true interests require it to extend its sheltering arm over them and to see that their people are free to follow her towards a higher civilization and a greater prosperity.

Is it not necessary to secure our possessions at home before we can hope to render secure those of other American states? We should not be over-confident because of the success of our last effort to enforce the Monroe Doctrine. We were then reasoning with a free people, accustomed to deliberate, loving fair play, with interest bound up in our own, and with many entanglements threatening. They preferred arbitration to war; but we must remember that sometimes it may require persuasion backed by force to carry out the decisions of the arbitrator. Some there are who would rely on our great wealth and large resources, but should their policy rule they will surely find that the resources will come into play too late and the wealth will be sacrificed to their error. Some would narrow and confine all commerce within the United States, would keep our citizens at home, sell and receive goods only at our own ports, and sympathize distantly with the ills of other nations. These may dam up our commerce for a time, but it must overflow all artificial barriers and spread in streams radiating in all directions. Steam and electricity have bound the world in too narrow a compass for even China to remain shut out from the family of

political, naval, military and commercial value. Ports will vary among each other in all these particulars. In New York they all unite to make it the most important port from all points of view. Here the immobile defenses should be sufficient, with the aid of the mobile army, to resist any probable attack, even when our fleet was not able to assist. Admiral Colomb gives the following rule for the strength of immobile defenses: "The only point to secure is that the enemy shall not be allowed to believe he can succeed in completing any open conquest before the arrival of the defending mobile force." In the term "defending mobile force" he included both army and navy. With the navy of Great Britain, maintained as it is at present, sufficient in strength to cope successfully with that of any two of the great powers, there is little or no danger of her fleet being many hours behind that of her enemy, and her army has comparatively small distances to travel. But our fleet might be held elsewhere by a superior force for some little time.

Commercial ports must be defended in some proportion to their importance, which may be increased by their being also naval or military bases, and in direct proportion to the depth of water that can be carried within gunshot of them. When of small importance they only need such defenses as will keep off cruiser raids, and as their importance increases so does their danger from stronger attacks and consequent necessity for stronger defense; but it is in no case advisable to protect against battle-ships when there is insufficient water to allow these vessels to come within the range of their guns.

Advance naval bases should require such protection as is necessary to render the base safe against cruiser raids, or such light attacks as might be attempted during the temporary absence of the guarding fleet. The point is that if the guarding fleet were absent it would be in touch with the fleet of the enemy, so that he could not afford to send away large detachments. The bases may require still stronger protection if they should happen to be the only suitable bases for an enemy attacking that portion of the coast. Then they should be able to withstand an attack in force.

When the cost of the immobile defenses of a coast, including maintenance, approaches the cost of the probable fleet that any possible enemy could bring against it, then that coast can be

defended far more securely by maintaining a fleet of commensurate cost without immobile defenses. For it must be remembered that even when all points of importance have been well covered by immobile defenses, the very thing that has made these ports of importance, their communications, may be easily cut off. And while the shipping and some of the wealth may be safely locked up within fortresses, values will fade away and wealth be diminished because the communications have disappeared. Again, although these fortresses may protect the actual vicinity of the port, it would be impracticable, with an extended coast line, to defend all possible landing points; and without a defending fleet the enemy could transport his army freely from point to point, avoiding fortifications, and probably outstripping the mobile army of the defense.

On the other hand the mobile defenses can only give perfect protection by being confined to specific localities, and thus losing some of their mobility. The navy should form the main coast defense and the fortifications the main harbor defense. Even Great Britain would find it impossible to give adequate protection to her coasts, colonies, and trade routes and lines of communication by her navy alone. She might have "command of the sea" in the larger meaning of the term, but she would be without local command for a time at many points. Her great ports, arsenals and fortresses would prove well worth a raid in force, and are therefore well worth protecting by immobile defenses against such raids. Her coaling stations also need immobile defense, only she should be careful not to let the secondary object obscure the primary and forget that local command is a small thing in comparison with the "command of the sea," and that while local defenses may strengthen the sea power, they can never give the command of the sea.

A national scheme of immobile defenses will provide sufficient protection to the permanent naval bases to prevent their capture by the sea force of the enemy. As next in importance should come the naval lines of defense. The advance bases on the lines should be so protected as to prevent their being seized by raiders during the temporary absence of the mobile defenses. There may also be found on these lines certain points so situated tactically as to admit of their acting with the fleet. Such points are to be found at the Race on the Gardner's Bay-Fisher's Island line; and at the Tortugas, on the Key West-Tortugas line.

A naval line of defense, such as those named above, is chosen at points of sufficient strategical importance, where the surroundings, topographic and hydrographic, permit the fleet to concentrate in force, and contains one or more advance bases where the immediate supplies of the fleet are kept. The line should be so situated that the fleet under way can co-operate with the forts to resist the attack; that is, the shore defenses would be so placed that the defending fleet could not be attacked without coming within the range of a number of the guns, etc., of the fortifications; and this not with the fleet at anchor under the guns, but capable of manœuvring and concentrating at that point of the line attacked. Thus the advance bases would not be fortresses where the fleet could retire and be masked by the enemy's fleet, but an extended line of fortifications which must be forced in the face of the fleet. Thus the Race would partake somewhat of the nature of a defile or pass, with the adjoining hills crowned with guns, and the defending army drawn across the further end, ready to crush the heads of the columns as they emerge from the pass.

A small but active fleet could hold such a line against a much larger force, and by meeting the enemy on the line, would be far more likely to do more damage to the enemy and have more influence in thwarting his purposes than by attacks when issuing from some fortress.

With these naval lines well fortified, and with a fleet of reasonable dimensions, large portions of the coast can be protected and the coastwise commerce remain uninterrupted. With the Gardner's Bay-Fisher's Island line well fortified, a small active "fleet in being" can hold a very large fleet at bay, and can force the enemy to keep his fleet together, thus protecting other portions of the coast.

Finally comes the immobile defense necessary for commercial ports. This should be proportioned to their importance and to the attractions they present to an enemy inducing him to make an attack; and it should be closely limited by the depth of water in the channels, for a large number of our ports are already protected by nature from attacks by battle-ships, and it is a great waste of strength to mount heavy armor-piercing guns when armored ships draw too much water to approach within gun range of the port. In considering the amount of immobile de-

fenses to give to any one place, care must be taken not to exaggerate its importance. It is well to remember that while the property itself may be held safe, that its principal value may be destroyed by the enemy for as long a time as he can cut off all communication. It is at this point that the mobile defenses come into play, and it is the part of the fleet to prevent this interruption or to shorten its duration.

During the war of 1812 our ports were well fortified for that time. The British fleet made no impression upon our ports, but for want of a defending fleet our commercial losses were enormous, and the value of our commerce diminished from about $250,000,000 to $21,250,000.

General Abbot paid great attention to the subject of defending our coast, and has written and lectured frequently on the subject; but he entertained the same error as is held by many military men, viz. that it is the duty of the army to provide safe fortresses for our fleets whence they can sally at will to assume the defensive. They imagine some large harbor, strongly fortified, where a fleet can lie idle, safe from the attacks of the enemy until opportunity arises to sally forth and strike him at a disadvantage. This is a most dangerous fallacy; a passive fleet has little opportunity for observation. History is against the efficiency of an idle fleet, and while some of the manœuvres of modern times appear to show that it is not difficult for vessels to escape from a blockaded port, they must escape in small numbers at a time. A powerful enemy first seeks to find his foe, and next to meeting him and crushing him on the high seas, he desires to bottle him up in some port from which he cannot move without his motions being observed; and from many such ports he can only come out in a formation presenting a narrow front and thus giving his enemy the advantage of gun fire. The safe rendezvous should be a line with bases, where the immobile defenses can aid the weaker fleet in sustaining an attack and can hold secure the necessary supplies. Another fallacy held by General Abbot was that shore defenses could prevent distant bombardment; and Lieut. Weaver advocated 20-inch guns that would serve to keep vessels off at a distance of six miles. To the naval mind this seems absurd, and it looks as if both our own and English army officers have an exaggerated idea of the accuracy possible with modern high-powered guns. It is true

that with range and position finders and with telescopic sights the guns can be pointed with remarkable accuracy, and the errors of modern guns are comparatively small; yet when one remembers the very small angle subtended by the largest battle-ship at long ranges, it becomes evident that the chances of hitting such a ship at anchor, much less when moving, are very small. Even with the correct range and the gun accurately laid, the slightest inaccuracy in the projectile, or difference in the quality of powder, and the projectile will fly wide of the mark. When the movement of the vessel with the time of flight of the projectile is further taken into account, it would seem that guns are not formidable when firing at ships from a great distance. When the city is so situated as to permit the use of barrier forts at a distance, then permanent works will serve to forbid distant bombardment.

Coast defenses when applied to fortifications are generally misnomers. They are usually harbor defenses, and are only coast defenses when defending advance naval bases. The true coast defenses are the vessels of the fleet. It may be necessary to use some portion of the fleet to assist the fortifications in defending a harbor. In this use the mobile defenses most closely approach the immobile, and the best quality of the vessels, their mobility, is greatly restricted. Great care must be taken to prevent localizing the sea force more than is absolutely necessary. Floating batteries should never be used where their work can be performed as well by guns on shore. There are some harbors, like San Francisco, where guns on shore will not afford sufficient defense, then floating batteries must be used, and they become part of the local defense, losing much of their mobility. Picket launches are needed to guard the mines in foggy weather, when the rapid-fire batteries on shore might prove insufficient; and torpedo-boats would prove most valuable weapons. These latter, when not sea-going boats, should be attached to districts and not to special ports, so that their mobility can be developed as fully as possible.

It is apparent from the newspapers, from the speeches in Congress, and from the appropriations granted, that the people of the United States have become impressed with the necessity of a secure defense, and after years of very small or no appropriations for fortifications and guns, comparatively large appropriations

have been made and the entire engineer corps of the army has been at work on plans for our numerous harbors. There is a great element of strength in any scheme of land fortifications when striving for appropriations; each locality is deeply interested in the fortifications in its immediate vicinity, both because of the additional security and because of the money spent and labor employed. This serves to bring votes, and strong efforts are made to obtain and to increase appropriations for this object, so that there is danger of the fortification bill becoming like the river and harbor bill, where local interests are apt to be more potent than national necessities. Were the public purse unlimited this feature would not be objectionable from a naval or military point of view, but as the appropriations are closely scanned and the sum-total to be spent for defense confined within narrow limits, there is great danger that what is given to the immobile defenses may be taken from the mobile, and the Navy may be left without chance of increase, the real safety of our coast sacrificed, and the mobility of our army destroyed by being localized and scattered among numerous fortifications.

On the other hand it does not do to put too small an estimate on the value and power of land defenses when properly used. High angle firing will be freely used, and with modern B. L. mortars the accuracy, rapidity and efficiency of high angle fire have been increased greatly. Anchoring within 10,000 yards of one or more mortar batteries would be to invite destruction. Here the large number of shots fired serve to make up for the inaccuracies of pointing. Motion, including both change of speed and change of direction, would be necessary to enable a vessel to remain within range with any reasonable degree of safety. Mortars can be placed so as to be almost, if not entirely, safe from modern high-powered guns mounted on board ship. As far as security goes the same may be said of guns mounted on disappearing carriages, their emplacements can be well scattered and yet their fire controlled by one commander. The range-finder and the improved ballistics of modern times permit quite accurate firing within reasonable ranges, so that it will be a most difficult task to destroy or to subdue the fire of modern fortifications by purely fleet operations. The ship can still run past the forts, and it must be arrested under the fire of the forts by submarine mines or other obstructions, or barrier forts will prove unsuccessful.

the forts, all without undue exposure to danger. The case is certainly different when mortar batteries and disappearing guns are used; their history has yet to be written, but knowing how little permanent injury has been inflicted on the fortifications by ships, the hope of silencing their fire, even temporarily, except by long bombardments, would seem very slight, and the rapid-fire guns would be of little value against guns so emplaced.

The Assistant Secretary, Mr. McAdoo, in his address delivered at the opening of the War College in 1896, clearly pointed out the necessity of a closer connection between the army and navy, particularly upon the subject of coast defense. Unless the navy is consulted in a matter so purely naval, the importance of shore defenses will be exaggerated to the detriment of our sea power, and the shore defenses will not be well suited to the purpose for which they are constructed. The nation may be lulled into a feeling of security by a large system of coast and harbor fortifications, while the great arteries of commerce may be exposed to the grasp of the enemy.

Lines suitable for the concentration of the battle fleet, such as the Penobscot-Portland line, the Gardner's Bay-Fisher's Island line, and the Key West-Tortugas line, are more important to the people of the United States than the fortification of any number of harbors. Until the mobile defenses on these lines are reduced no great operations can be undertaken by the enemy, and large portions of the sea-coast communications will be protected. It is the duty of the naval officer to select and point out these lines, to point out what class of attack is likely to be made upon any port or base, and to prevent extensive fortifications being erected where only light draught unarmored cruisers may be expected to conduct the attack.

The naval force should not be localized, but should be concentrated and placed between the enemy and our communications along carefully selected lines. The fortifications can only protect their immediate locality and cannot prevent the enemy from interrupting the communications. Each has its advantages while utilizing its peculiar functions, and each becomes extravagant when usurping the functions of the other. It would be far better to have some of our largest ports laid under contribution, their shipping destroyed and their docks laid waste, than to have our water communications blocked for an extended period. And far

better that the country should have no navy than that its vessels should be scattered and locked up in various ports for harbor defense.

The Fleet in Being.

When defending our coast by occupying the lines with fortified bases our fleet must be handled as an active "fleet in being," and the doctrine of the "fleet in being" becomes of great importance to us.

The value of technical phrases is readily appreciated by all of us. Such phrases as "Sea Power," "Command of the Sea," "Fleet in Being," etc., are of great use as serving to crystallize a set of ideas into a few words. But the use of these phrases is not without danger. To the non-technical mind an argument bristling with technical terms is apt to be convincing even if the foundation is weak; but this is the lesser danger. The real danger is that students of the subject are inclined sometimes to enlarge the idea until the facts upon which it rests are lost sight of. The term "Fleet in Being" has at times been so badly misused as to cause much controversy. Some have so lost the substance while retaining the form as to endow the weak fleet with powers far beyond those it could hope to exercise.

The difficulties encountered when studying naval history are very great, especially so before the advent of the luminous writings of Mahan, Colomb and Laughton; and the ruling laws of strategy and tactics are so clouded by collateral events and conflicting narratives that in ascertaining these laws the deductive method is apt to be preferred to the inductive, and the theory is first formed and afterwards the facts are hunted up from many examples. This sometimes leads to a distortion of the facts to fit the theory, and may serve to weaken a good theory or to bolster up a bad one.

The term "fleet in being" was first used, I believe, by Admiral Herbert, Lord Torrington, in his defense made by him during his trial after the battle at Beachy Head. Torrington was tried and was acquitted in spite of the efforts of the ministry. Admiral Colomb seized upon the term and has used it in illustrating one of the laws of strategy in his most valuable book, "Naval Warfare." The conduct of Torrington on that occasion has been the source of much dispute, and writers have put many interpreta-

enemy, and frustrate any hostile action he might attempt by attacking him at such times when he would be liable to defeat. Had Torrington's fleet been found by Tourville at anchor in the Nore and showing little disposition to come from behind the banks, Tourville might have left a few vessels in observation and proceeded against Killegrew's or Sir Cloudesley Shovel's fleet, and he might have succeeded in beating them in detail. But he found Torrington's fleet was keeping in touch with him and was attacked by him, so that he felt certain that Torrington would continue to be an active "fleet in being" and follow his actions closely.

Mr. David Hanway, in an article in the New Review for October, 1895, attacks the generally accepted idea of the "fleet in being." He says: "All through the arguments of the believers in this kind of fleet [the fleet in being] it is taken for granted that there are some trustworthy means of avoiding battle and yet paralyzing the enemy." "What the partisans of the 'fleet in being' have got to prove is that there are some means—not dependent on accident, or on the presence in the hostile ranks of cause of weakness, due to moral, material or intellectual conditions—which enable a force, so far weaker that it prefers to avoid battle, to escape being forced into action, and at the same time to 'paralyze' its opponent." Admiral Colomb answers him in four articles in the Broad Arrow for October and November, 1895. In these articles he plainly points out the limits of the "fleet in being," that is, that while this fleet is in active existence there is a limit to what the more powerful fleet may reasonably expect to accomplish and that there is no occult power invested in the mere name. He says, speaking of Torrington, "But he knows that when it [his fleet] was intact and in sight of the French fleet, and when it was at the Nore repairing damages after the battle, the question was for the French, not for the English. The French 'would not *dare* to make an attempt.' 'Had they dared,' he seems to say to us, 'I should have attacked them at all hazards, and the knowledge that I would attack them at all hazards is that which would prevent them from daring.'" That is, that it was too hazardous for a wise admiral to attempt to land troops in the face of an active fleet. He also quotes De Tourville: "If they had thirty ships of war more than the fleet of your Majesty they might make their disembarkation, while

leaving ten ships of war with their transports and coming with the rest of their fleet before that of your Majesty in order to offer it battle." Here the main fleet would paralyze the "fleet in being," while there would be sufficient force left to guard the disembarkation against a few escaping vessels or scattered effort. Again Colomb says: "When we prepared for the capture of Belleisle in 1761, Keppel took seventeen sail of the line to cover the landing of 10,000 men, and he dispatched twelve sail of the line and three frigates to Brest to mask the force there. It is safe to say that Belleisle would not have been attacked if there had not been there twelve sail of the line over and above the force necessary to cover and support the landing." Had such been the case the inferior "fleet in being" in Brest, by its effect on the mind of Keppel, would thus have kept the island in the hands of the French.

Again Colomb says: "There is positively nothing in the phrase 'fleet in being' and in the doctrine behind it than the question of the amount of naval force any power must provide which thinks of undertaking serious invasion. Torrington could not possibly have meant more than what De Tourville said in his memorial to the King of France. Any power undertaking to invade a country over the sea must provide two fleets, one to cover the landing, and the other to mask, overawe and 'paralyze' any naval force that the enemy may possess, and which, but for this 'paralyzing,' might be expected to interfere with and perhaps stop the landing, as Tegethoff did at Lissa."

A discussion on this subject was raised in the Army and Navy Gazette, August and September, 1895, by an editorial on an article that appeared in Macmillan. This discussion is particularly valuable, as during it Professor Laughton gave a definition of the phrase "fleet in being." He says: "A 'fleet in being' is a fleet which is neither cowed, crushed nor effectually masked, and is still able to threaten interference with an enemy's plans of territorial attack." This is clear and to the point; but I think for the sake of accuracy it should be limited slightly in one direction and extended in another. The following definition, which is Professor Laughton's slightly amended, more accurately represents, I think, the present doctrine: A "fleet in being" is a fleet, *relatively inferior to the enemy*, which is neither cowed, crushed nor effectually masked, and is still able *to observe*

States in time of peace, but to endeavor to show how important they must be to the United States in time of war, from their strategic position. Any one considering the defense of our eastern coast must see at once the difficulties that would be removed with Bermuda out of our way, and the advantages they offer to Great Britain should she be the attacking party. The Hawaiian islands would not be as valuable as Bermuda to an attacking enemy, because of their greater distance from our coast, but they would be more valuable to us as a point from which to defend our transoceanic routes. It would not be difficult for us to hold the same position in the northeastern Pacific towards other naval powers that Great Britain holds in the remaining waters of the world; and if we really develop our foreign commerce and take advantage of the new and most valuable openings for trade in China, the only rival who should closely approach us in sea power would be Japan.

The advantage of outlying ports and coaling stations, in times of peace, is freely admitted on all sides. The controversy arises when the possibility of war is considered. The wisdom of Great Britain in seizing and holding her imperial fortresses, Halifax, Bermuda, Gibraltar and Malta; her imperial coaling stations, fifteen in number; and her other defended outlying ports, twenty-one in number, can hardly be denied; but then, say some strategists who carry the theory of "command of the sea" to extremes, Great Britain can hold these ports with honor and safety, as she holds command of the sea; but for other countries to do so would serve to weaken their power by attempts to defend them, and in the end would be furnishing an easy prey for the forces of Great Britain. And right here is a comparison used by nearly all strategists, a natural one, but one which if carried too far leads to error. It is natural to compare all sea force with that of the country pre-eminent in such force; but it would be foolish for a country to relinquish advantages or safeguards because, as against Great Britain, they might prove disadvantages or dangers, for there are other countries besides Great Britain who are struggling for the commerce of the world. This misconception of the theory of the command of the sea leads some to object to our attempting to hold Tortugas, and leads some of the French into the idiocy of commerce-destroying and torpedo-boat defense.

There are to be found men even in Great Britain, generally termed "Little Englanders," who would relinquish Malta and Gibraltar and would withdraw from the Mediterranean, because Great Britain would find it difficult, under some circumstances, to hold command of that sea, and because by relinquishing all effort there she would be stronger at other and more vital points. Relinquishing Malta and Gibraltar would be the first step on the road that leads to the disintegration of the British Empire and to the re-establishment of "Little England."

Let us see how far such an argument, if logically carried out, would take the "Little Englanders." Great Britain has long reigned paramount in the China seas. With her chain of ports and colonies between China and the mother country she has found it easy to maintain the strongest naval force in those waters, resting on Hong Kong as a base. But the condition of affairs in those seas is changing rapidly, and it is not hard to foresee the time when she will find it difficult and extremely expensive to maintain a fleet equal to that of at least two of the nations interested in those waters. Germany has made great advances in her trade with China, and Germany has a growing desire for colonies and a determination to create a large navy, but she has no chain of ports and no base at present in the China seas. France has been extending her territory at the expense of China. Her navy is second only to that of Great Britain. She has a broken chain of defended ports in Dakar, Reunion, Diego Suarez and New Caledonia, and a base at Saigon. Russia's territory borders China, her navy is large and increasing, she has the home base of Vladivostock, and this fortress will soon be connected by rail with the seat of her resources and her power. Russia, France and Germany dictated the terms of the China-Japan treaty, while England held aloof. But most important of all, a new sea power has arisen in the East, and Japan is now creating a navy that she can maintain easily at a strength greater than the forces that any other power can maintain in the China sea without great exertion and enormous expense. The manifest destiny of Japan, unless her new civilization be checked, is to be the great maritime power of the East. Would the "Little Englanders" withdraw from Hong Kong, relinquish their influence in China, and retire to India, because she cannot command all the China seas? What

command of the sea at such a point for any useful period of time, and at any time after the outbreak of war she could reduce it without fear of definite resistance from our sea forces. Whereas for us to hold the Tortugas or Bermudas would be to multiply our resources, as we could hold local command of the sea at such points, and such places could not be reduced until after our fleet had been crushed, and the possession of fortifications at these points would so strengthen our fleet as to require a much superior force to crush it. It must be remembered that cross raiding has little effect on the final results of a war. All the valuable possessions of the defense may become the property of the attack when it is successful, and improperly selected bases of the defense may fall to the attack without diverting it from the main issue, but well selected bases become an integral part of the defense and enable it to resist the attack, and should only fall after a complete failure of the defense, or after costing the attack such an expenditure of time and material as to proportionally weaken it. Not to create a naval force of sufficient power to make well selected bases valuable is to relinquish the attempt to conduct a successful defense against a maritime power, and to relegate all the vessels of war and all the fortifications near the sea front to attempting to defend isolated localities against strong attacks, so that a well equipped enemy could seize our fortified points one by one and even dominate our coasts without giving us the opportunity of making more than a feeble resistance. Would it not be better to trust to peaceful arguments to avert war, and when these fail to pay an indemnity to the aggressor, than to aggravate the enemy into increasing our penalty by making a feeble resistance? There can be no question but that in the present state of the morals of the inhabitants of this globe force must be met by force, and putting aside questions such as avenging insults, vindicating principles or righting wrongs, there still remains the necessity for a strong naval force with well fortified bases for the sole purpose of protecting our coasts and safeguarding our wealth, if not our lives and our liberties.

The Nicaragua Canal.

An interoceanic canal connecting the Atlantic and Pacific oceans has long been desired by the merchants of all nations, and one under the protection of this country has for some years

been advocated by our statesmen and has strong support among our thinking people.

Among the many routes proposed, two have been accepted generally as the best, that is, Nicaragua and Panama. Any one examining the surveys and reports and weighing all reasonably accurate data would be at a loss to explain the selection of the Panama route, if unacquainted with the reasons other than economic that determined its choice. The history of the Panama canal is fairly well known at the present day. How, after the expenditure of millions, but little valuable work was left to show for the money that had taken wings, and how at the present time, after a slight resurvey, a pretense of work is again being made without any real attempt to overcome the serious natural difficulties.

It is difficult to believe that the Tehuantepec ship-railway was seriously considered by any number of men of importance, but it has been used to retard the important undertaking in Nicaragua.

Few can doubt the great commercial advantages to this country of an interoceanic canal; even the transcontinental railroads must see that although they may lose some heavy freight, that they must be the gainers by the establishment of a canal that will serve to increase the prosperity of both coasts and therefore increase the freight and passengers moving over their lines. Competition between rail and water routes is never real and never lasting; each route soon carries the class of freight for which it is peculiarly adapted, and the prosperity of one is increased by the establishment of the other.

Only those who believe in the certainty of universal peace in modern times can look without alarm upon the building of a canal between the Atlantic and the Pacific by a company virtually if not nominally under the protection of a European power. A new state on the American continent under the protection of a European power would be less menacing to the vital interests of the United States.

The commercial advantages of such a canal being admitted, so far as the interests of the United States are concerned, the next question is one of military policy. It does not require an expert to see the enormous advantages and great gain to the military strength of the country that have resulted from the close commu-

nication established by means of railroads between the Atlantic and Pacific States. When the mind is not clouded by the idea that forts form a satisfactory coast defense, and the value of ships is clearly understood, the advantage to us of a means by which our naval force can be concentrated on either coast becomes apparent. For then we would have no rival in the race for the command of the sea in the eastern Pacific, and our position in the Atlantic would be greatly strengthened. The radical difference between the railroads and a canal is that the former lie within our own territory while the latter must be located at some distance beyond. The one requires military and the other naval protection. The one is already secure; the other must be made secure by holding the command of the connected seas if we are to fulfill our manifest destiny and become a great manufacturing country.

Does such protection require a more powerful naval force than would be otherwise necessary to safeguard the interests of our country? It does not do to consider any of the great interests of a country as if they were so many isolated quantities, as in so doing grave errors must be committed. Doing so might lead to the following reasoning: That there was no utility in constructing a canal because of lack of commerce; no use to increase our commerce because of lack of naval force for its protection; and no use to build up the Navy because there was no canal and no commerce to defend. We cannot become a great manufacturing state or dispose of our surplus farming produce to advantage unless we increase our commerce. We cannot greatly increase our commerce unless we increase our merchant marine. We cannot increase our commerce and our merchant marine without increasing our responsibilities and therefore increasing the need for a naval force. With a naval force commensurate with our necessities we must become the dominant naval power in American waters, and the safety of all routes between the Atlantic and the Pacific be secured.

The consideration of the protection of the Nicaraguan canal draws out similar lines of argument to that of the protection of fortified bases. The distance of the canal from home bases becomes of vital importance. Any one of the great naval powers of Europe might maintain in its own waters an overwhelming force as compared to ours, and yet be unable to hold command of the

Caribbean sea or to attack Greytown with reasonable chances of success. Some of these powers have bases in these waters, while up to the present time we have neglected all our opportunities; but while these advance bases would enable them to maintain a limited force for a limited time in the waters in question, the distance between the advance and home bases would prevent them from maintaining a powerful force there, and would make it doubtful for a limited force for an extended period during war. Without advance bases, except such as would be seized at the time, a powerful force operating in these waters would be possible for us when impossible for a European power, and with proper advance bases we could maintain command of the Caribbean sea without straining our resources. The problem on the Pacific coast is less complicated. There the ease with which we can command the sea is apparent, and it only requires a little thought and use of opportunities to prevent unnecessary expense.

Depth and Draft.

The depth of water in the channel leading into any harbor should be the ruling element in the design of its defenses. For the draft of the attacking ships is limited by the depth of the channel, and the armored protection of the ship is somewhat proportional to its draft. Ships may be heavily armored and yet be of light draft, as are our monitors; but in securing light draft and maintaining heavy armor and armament, coaling radius and seagoing qualities have been sacrificed. It is not likely that any such vessel would cross the ocean to attack our coasts. Again it is the general rule, although there are notable exceptions, that the calibre of guns corresponds in some degree with the amount of armor carried. Small calibre guns do not require very heavy fortifications, and it would seem reasonable that the class of guns to be carried in the forts should be determined by the class of ships that is likely to attack them. A well located shell from a large calibre gun, 10-in. and upwards, would be sufficient to seriously damage or destroy an unarmored cruiser. But large calibre guns are loaded, aimed and fired slowly, and the percentage of hits in actual combat is not likely to be large, even if the vessel is not moving rapidly, and of course the percentage of well located hits must be much smaller. A fair sized battery of rapid-fire guns would be almost certain to stop a cruiser that

might pass a few 10-in. guns without serious damage; and the cost of such a battery would be much less than that of the emplacements, carriages and guns of the heavier calibre. When unarmored vessels only can be expected to make the attack, the defense made by a rapid-fire battery would have the advantage over guns of larger calibre in the points of efficiency and expense as well as of choice of location, etc. That the greater range of the larger calibre can be neglected fairly must be admitted by all who have given the subject full consideration. At great ranges the slightest change in the weight or conformation of the projectile, in the quantity or quality of the powder, in the temperature of the gun, in the condition of the atmosphere and in the direction of the wind, the slightest difference in any one of these uncertain quantities is sufficient to cause a clean miss.

Let us consult one of the late lists of the war vessels of Great Britain and pick out all the armored vessels drawing less than 20 feet. We find the Penelope, 4470 tons, drawing 17 ft. 6 in., capable of steaming 1360 miles at 10 knots speed, carrying eight 8-in. muzzle-loading rifles and protected by 6-in. armor. The Glatton, 4910 tons, draft 19 ft. 6 in., steaming radius 2000 miles at 10 knots, guns two 12-in. muzzle-loading rifles, armor 7 to 14 in. The Cyclops, Gorgon, Hecate, and Hydra, 3560 tons, draft 16 ft. 4 in., steaming radius 1250 miles, guns four 10-in. M. L. R., armor 5 to 10 in. The Magdala, 3340 tons, draft 15 ft. 3 in., steaming radius 800 miles, guns four 8-in. B. L. R., armor 7 to 10 in. The Abyssinia, 2900 tons, draft 15 ft., steaming radius 1000 miles, guns four 8-in. B. L. R., armor 6 to 10 in. The Scorpion and Wivern, 2750 tons, draft 17 ft., steaming radius 1150 miles, guns four 9-in. M. L. R., armor 4.5 to 5 in.

All of these vessels are armored with iron plates, and their water line belt can be pierced by 6-in. guns. All are slow, and only one carries sufficient coal to steam 2000 miles. All but two are armed with muzzle-loading guns. The two armed with breech-loading guns were built for the coast defense of India and have a very limited coal endurance. In fact we may conclude that all of our ports whose channels have only 20 feet of water are secure from attack by armored vessels except where sufficiently near the sea to permit of distant bombardment.

Again consulting the list for vessels drawing under 25 ft. we find the following in addition to those already mentioned. The

Conqueror and Hero, 6200 tons, draft 24 ft., steaming radius 5200 miles, guns two 12-in. B. L. R., armor 8-in. to 10-in. compound. The Audacious, Invincible, and Iron Duke, 6010 tons, draft 23 ft. 8 in., steaming radius 3900 miles, guns ten 9-in. M. L. R., armor 4-in. to 8-in. iron. The Belleisle and Orion, 4870 tons, draft 21 ft., steaming radius 1850 miles, guns four 12-in. M. L. R., armor 6-in. to 12-in. iron. The Rupert, 5440 tons, draft 23 ft. 7 in., steaming radius 1350 miles, guns two 9.2-in. B. L. R., armor 7-in. to 12-in. The Hotspur, 4010 tons, draft 21 ft. 10 in., steaming radius 950 miles, guns two 12-in. M. L. R., armor 7-in. to 11-in. iron. The Prince Albert, 3880 tons, draft 20 ft. 4 in., steaming radius 950 miles, guns four 9-in. M. L. R., armor 4.5-in. to 5.5-in. iron. And the Aurora, 5600 tons, draft 22 ft. 6 in., steaming radius 8000 miles, guns two 9.2-in. B. L. R., armor 10-in. to 16-in.

Of these the first five are the only ones that could be brought against our fortifications. The first two are fairly formidable vessels, but their armor can be pierced by 8-in. guns. The Audacious, Invincible, and Iron Duke could not work their muzzle-loading guns against a battery of rapid-fire guns, and a large proportion of their armor can be penetrated by 6-in. guns. England has many formidable battle-ships, but they all draw over 25 feet and many closely approach 30 feet. So that for harbors whose channels have only 25 feet of water, except when it can be bombarded from the sea, the defense will be stronger if rapid-fire guns are used than if larger calibre were preferred. Even where the exception rules, guns of heavy calibre may make bombardment slightly dangerous, but it can only be prevented by the use of battle-ships and torpedo boats.

Now if we examine the charts we will see how very few harbors of importance will admit vessels drawing over 25 feet. Portsmouth, Newport, New London, New York, Baltimore (by a dredged channel), Key West (by the S. W. channel which is not safe), and New Orleans (kept open by jetties), are the principal deep water ports on the Atlantic Coast. It is expected that Boston and Norfolk will have 30 feet dredged channels at an early date. These harbors would require shore defenses against battle-ships, remembering that dredged and other narrow channels can be readily rendered impracticable with ground mines and other obstructions.

In reviewing the report of the Chief of Engineers, for the last year, one is struck at once with the large amount of work that has been completed on emplacements for heavy guns and mortars as compared with that for smaller guns. To be sure there are two good reasons for this, one that such important ports as New York require many heavy guns and mortars, and the other that as emplacements for the heavy guns take far longer than those for rapid-fire guns, it is well to undertake the installment of the heavy guns first. There are some points where even heavier guns could be used to advantage, and others where it is to be hoped heavy guns will be installed, but surely ten-inch guns are not required at Portland with 21 feet of water, or at Washington with 20 feet, or 12-in. guns at Charleston with only 15 feet of water. If these guns are intended to prevent distant bombardment they should be of heavier calibre, certainly not less than 13 inches, and if they are intended to drive off cruisers they are too large. The recommendations of the Endicott Board appear to be the guides that are being followed, but conditions have changed somewhat since they were made, displacements have increased and consequently draft, armor has been improved, the rapid-fire gun has been developed, and the plans should be altered to meet the new conditions.

Type of War-Ships.

All naval powers appear to be agreed upon the necessity of three broad types, viz. battle-ships, cruisers and torpedo boats; but armored vessels are constructed upon largely varying designs, so that there are not only numerous other types besides battle-ships, but there are many vessels that are placed in one type by some authorities and in another type by others. The line between battle-ships and armored cruisers is far from distinct. Again, heavily armored vessels differ so in their steaming radii as to range from vessels fit for little besides harbor defense, through coast defense vessels, to sea-going battle-ships. Cruisers are so varied in design as to furnish examples to suit the most erratic fancy. Torpedo boats range from destroyers of about 350 tons to small launches. Besides these we have vessels designed for special purposes, such as rams, dynamite cruisers, etc., etc.

The question of the necessity of building battle-ships has been raised frequently. The strongest opposition to them is centered

in France, and Admiral Aube has a large following, but they have been unable to control the building policy of that country for any extended period of time, and France continues to build battle-ships, although the designs are somewhat controlled by similar ideas to those that would stop their building.

In analyzing the many arguments raised in France for and against the building of battle-ships, the ruling idea that appears to permeate those from the new school is that there is one type suitable for the strong naval power and another for the weak. That France cannot afford to build and support such great fleets of battle-ships as England has built and is building, and therefore should put her faith in fast cruisers and torpedo boats. That there is one set of rules of strategy for the strong and another for the weak. Similar ideas led to our policy of building gun-boats instead of ships of the line and frigates, and has led to the building of many harbor defense vessels. Such ideas can only prevail because of a thorough misconception of the uses of sea power and the history of sea fights, and restricts the area of the influence of sea forces so as to make them little more than adjuncts to land forces. They limit the final operations of battle-ships to attempting to knock down forts, and would make the destruction of a great coast fortress valuable, even though it belonged to a country without naval or merchant marine. In other words, they fail to see that the true value of a fortress is to protect the inlet and outlet for trade, the vessels carrying the trade, the vessels protecting the trade, and the supplies, munitions of war, repair shops, etc. Without the vessels the fortress loses most of its value, and with the vessels cooped up within its protection its value is measured by the force of the enemy required to close its mouth. If they build any battle-ships they would build them to protect their coast, and they build fortresses to protect their battle-ships. The problem of selecting sites for fortifications on and near the coast line does not differ greatly from that of selecting them in the interior. Few engineers of the present day would think of designing immense fortresses with the idea of safeguarding an army inside. The example of Metz would be sufficient alone to prevent like errors. Why then Bazaine our fleets? Fortifications are designed to strengthen portions of the line of defense of an army, and to protect its supplies, munitions of war, and lines of communication, but not to enclose it. The value of an army is

mainly dependent upon its mobility, and, although fortifications may be built around a city to strengthen its defense, the army that should seek refuge within would be partially defeated, its value for the time seriously diminished, and even the defense of the city weakened. So with coast and harbor fortifications; they should be designed to strengthen the lines of defense of the battle fleet and to protect its supplies, etc. They should also be designed to protect cities and harbors, and usually these would include points of supply. But the battle fleet, like the army, should have room to manœuvre even when fighting on the defensive.

Battle-ships are not designed to attack land defenses, but to meet other vessels on the sea; and, while they may at times successfully bombard fortifications, they will do so only under exceptional circumstances, and will need land forces to succeed in extensive operations.

The greatest blow to the adherents of battle-ships has been struck lately by Admiral Colomb. The blow is severe more because of the high reputation of its author than from the weight of the argument. Admiral Colomb is one of the most advanced thinkers on naval subjects, and, in my opinion, his deductions from history are better guides than those of any other modern writer. This makes his predictions as to battle-ships the more surprising. What might be brushed aside if uttered by other men requires careful consideration when it comes from the mouth or pen of Admiral Colomb. There is one saving feature in the case, and that is the well known tendency of the Admiral to make assertions when desiring to evolve an argument and to force consideration of a subject, that, while expressing his views, are easily twisted into other meanings. In fact, any one holding opposite opinions to the Admiral is apt to argue as if the Admiral held extreme views, and then he finds he has been fighting the air, as the Admiral comes back with a clearer statement of his ideas. In this case it seems as if there were no opportunity or excuse for misstating the views of Admiral Colomb, and that he has plainly placed himself on the side of the destroyer as opposed to the battle-ship, and that he believes it is time for Great Britain to cease building large battle-ships, that an entire change in type is necessary, and that something similar to the destroyer type should take the battle-ship's place. He assumes that the battle-ship has

reached its final stage of development, that the type has reached its highest point of efficiency, and that the logical deduction from this assumed fact is that a new type must be evolved to fight in the line of battle. This new type he seems to think will be of the nature of a modified destroyer. He seems to think that a number of destroyers, whose aggregate cost would be less than the cost of one battle-ship, would be more than a match for her.

If there is any one thing more than another for which Admiral Colomb is justly celebrated it is his power of predicting the future and guiding the present state of naval affairs by lessons drawn from the past. One can readily imagine how he would have scathed an advocate of a policy of building small vessels to take the place of the great vessels of the line, and what ponderous blows he would have aimed at his adversary had he not been imbued with ideas that have forced him to take the side of the small vessels. Under other circumstances what admirable examples he would have drawn from history to show the necessity of battle-ships, and how he would have shown that in each change of design the logic of events forced the building of greater vessels. Now he is limited to one lesson of the past, that is, when a type approaches the point of perfection a new type better adapted to the modified circumstances must be developed. One cannot cease to regret that a writer so powerful in argument should be found arrayed against the battle-ship.

One of the strongest examples of history that can be brought forward on the side of the small vessel is the defeat of the Spanish Armada. Here the small swift vessels of the English were more than a match for the large unwieldy vessels of the Spanish, yet England and the maritime world did not draw the false conclusion that smaller vessels were the best—they modified their vessels of the line so as to make them sufficiently powerful to overwhelm a large number of the smaller vessels.

Froude, in his lecture entitled "The Sea Cradle of the Revolution," speaking of the reign of Henry VIII, says: "Genius kindled into discovery at the call of the country. Mr. Fletcher of Rye (be his name remembered) invented a boat the like of which was never seen before, which would work to windward with sails trimmed fore and aft, the greatest revolution yet made in shipbuilding." This was about the year 1539. All through the set of lectures delivered by this author at Oxford, 1893-94, the advan-

tage of this invention can be traced, and the evidence that the Spanish were backward in adopting it. "Their safety depended upon speed of sailing, and specially on the power of working fast to windward, which the heavy square-rigged vessels could not do." "The Pelican sailed two feet to the Cacafuego's one." "However that be, the brigantines and sloops used by the Elizabethans on all adventurous expeditions were mere boats compared with what we should use now on such occasions. The reason was obvious. Success depended upon speed and sailing power. The art of building big square-rigged ships which would work to windward had not yet been discovered, even by Mr. Fletcher of Rye. The fore and aft rig alone would enable a vessel to tack, as it is called, and this could only be used with craft of moderate tonnage." (1562.) "With some surprise the Spanish officers saw Howard reach easily to windward out of range and join Drake." (Sailing of the Armada.) "New-modeled for superiority of sailing, the English ships had the same advantage over the galleons as the steam cruisers would have over the three-deckers. While the breeze held they went where they pleased." (Same.) "The English ships had the same superiority over the galleons which steamers have now over sailing vessels. They had twice the speed; they could lie two points nearer to the wind." (Defeat of the Armada.) There were other things that led to the defeat of the Spanish Armada, but the small swift schooners of the English were the most important factors. They could choose their position so as to inflict the greatest injury to the Spaniards while receiving the least harm. Their low sides made them difficult to hit, and their power of beating to windward enabled them to move around the unhandy galleons at will, when there was sufficient wind. Their armament was superior to that of the galleons, and with some little increase in calibre of their guns they would have occupied the same position towards the ships of the line that the destroyers do to the battle-ships at the present time. The galleon was improved. The sails and spars were so improved as to permit of the square-rigged vessel making very fair work to windward, and the armament was so improved as to insure sinking the schooners at a single broadside. Each great change in type has resulted in an increase in the size of vessels designed to fight in the line of battle, from the introduction of sails, through that of steam, up to the mastless ironclad.

It would seem as if the limit in size had been reached, at least for the present, but it is going very far to assume that the present type has neared its highest point of perfection.

The present position seems to be this—that the small size and great speed of the destroyer, together with the power of its weapon, make the destroyer a most formidable enemy to the battle-ship. Many consider that at night-time several destroyers would be almost certain to defeat a battle-ship, and possibly in the day-time. Admiral Colomb appears to advocate a vessel somewhat larger than the present destroyer and with some armor. If destroyers are designed of over 350 tons displacement they must be of inferior speed to the present ones (with the engines and boilers as at present designed), or else they must sacrifice a greater percentage of displacement to their motive power than is sacrificed in those of 300 to 350 tons. It has been pretty conclusively proved that for the same speed a smaller percentage of the displacement is required for the motive power in vessels of about 300 tons than in any other displacement until quite high figures are reached. So that, even without armor, larger destroyers must have less speed than those of the present size. It would require considerable armor to protect against 12-pounders, although comparatively light armor would be sufficient to keep out 1 and 6 pounders. The larger destroyers would lose much of the invulnerability of other torpedo boats due to their small size. The modern destroyer is a very wonderful weapon and admirably suited to the purposes for which it was designed, the destruction of torpedo boats, but must have its limitations as have other warlike instruments. The destroyer is not the first weapon that in the earlier stages of its development was expected by its ardent admirers to revolutionize naval warfare, that is, was to change completely the design of vessels fit to fight in the line, but it is surprising to find Admiral Colomb apparently arrayed on the side of those predicting a revolution. The torpedo and ram each had its day, each made its mark on the designs of the times. They created no revolution, but they did force modifications in design. The gun regained its ascendancy over the ram and torpedo, and the torpedo boat was limited by its vulnerability to operating in the dark or in thick weather, and by its endurance to operating at short distances from its base and in smooth water. Now arises the destroyer; it will have also its effect on the design of battle-ships; it will find also its limitations.

The battle-ship is not well suited to attack land defenses, and when well designed and of sufficient strength fortifications limit the area of a battle-ship's operations. Its area of operations may be limited also by light-draft rams, as they would prove most formidable at points where vessels of heavy draft were confined to navigating narrow channels. Torpedo-boats limit the area of operations of battle-ships, in that they become dangerous in narrow waters and near the coast, in darkness or thick weather. Submarine torpedo-boats may have also their limiting effect, in that they may make it dangerous for battle-ships to approach too nearly their bases even in daylight and in clear weather. In all cases the probable danger to the battle-ship may be greater than the possible good to be gained by the attempt. But in the struggle for the command of the sea the battle-ship still reigns supreme, because the battle for the supremacy must be fought at sea by vessels capable of sustaining themselves at sea. This is the broad lesson to be drawn from all history, from all experience both ancient and modern. The real difficulty that has confronted many students of naval history, and has served to mislead the advocates of special weapons, is the attempt to make general rules from particular cases. Seeing that many naval actions have happened near the land, they have exaggerated the importance of the narrow strip of water that adjoins the sea-coast, and have failed to realize that the force whose coast-line was attacked had been driven first by superior naval power from the high seas. It is this exaggeration of the importance of the strip of water adjoining the land that has served to introduce erroneous theories into both strategy and tactics. If Great Britain commands the ocean, France will benefit little from holding Toulon and Brest; and if France commands the Mediterranean, Gibraltar and Malta will be of little utility to Great Britain. It may be advisable, in order to terminate a war, to attack fortresses and occupy ports, but the most important work has been accomplished when the enemy has been driven from the high seas.

The fall of Sevastopol was insured when the Russian fleet was locked up in the waters protected by that fortress; and with all the glory gained by Todleben for his defense of Sevastopol, he might have served his country better had he retired from its walls, in place of furnishing by his energy and science a force sufficient

to hold it, and thus inducing Russia to diminish her resources by attempting to maintain a relieving army in the Crimean peninsula unaided by a fleet. In warfare on land fortresses have often been mistaken for the real objects of war, and the land forces, that otherwise might have marched to victory, wasted in their reduction. In naval warfare the same errors may be made. Farragut would never have occupied his present place in history had he wasted his resources by attempting to reduce the forts below New Orleans or Mobile.

If it be true that the field to be contested by warships is the high seas, then surely the battle-ship must be a vessel capable of keeping the sea—a sea-going vessel. Weapons may be designed that still further limit its area of action, blockades made more difficult and the protection of commerce less certain, and both may require stronger forces than at present; yet the force superior in strength and energy, if properly handled, must win. Our own war of the rebellion has been often quoted to show the difficulty of maintaining a blockade, and long lists of blockade-runners who have successfully eluded the blockaders are shown to prove how incomplete the blockade was; but does any one imagine that the efforts of the blockade-runners had any vital effect on the war? Can blockade-runners subsist armies, or the gains of a host of adventurers serve to replace the profits of legitimate commerce? Many were the English vessels that fell victims to our privateers in the war of 1812, and there were other enemies striking at the same prey, yet the commerce of Great Britain continued to increase while ours faded away.

The great advantage possessed by the destroyers, besides their small size, is the very high speed of which they are capable; but they can maintain this high speed for only a short time. They have a moderate steaming radius when proceeding at a moderate speed; but should they meet an enemy at sea, at a good distance from land, they would be unable to use their high speed unless they relinquished all idea of again reaching land. If they were met by an enemy near the end of, to them, a long voyage they would not have sufficient coal for high speed. And they could not remain off a port for any reasonable time and yet have sufficient coal to utilize the most important feature in their design —high speed. Again, destroyers must be small-sized vessels, and therefore must lose their speed rapidly, as compared with

large vessels, in a rough sea. In fact, except under unusual circumstances, a flotilla of destroyers must fall victims to large vessels on the high seas. Any one who has closely watched the history of the many destroyers now afloat must be convinced that they are frail boats, far too frail to allow of reliance being placed upon them in emergencies that require them to operate at a distance from their base. Weights have been so fined down that accidents are numerous, and the best of them require overhauling after a comparatively short experience of high speed. It would seem as if the function of the destroyer having been exaggerated so as to include the destruction of battle-ships on the high seas as well as the destruction of torpedo-boats, an attempt has been made to increase desirable qualities beyond the limits inherent in the design, and thus reliability and consequently efficiency have been sacrificed.

The battle-ship may be improved in several directions so as to make the destroyer's fate more certain; and yet the battle-ship may find its area of action still further limited by the advent of the destroyer, although employed within its legitimate sphere. But it would be a serious error for any maritime country and would be suicidal for Great Britain to neglect building battle-ships.

An inspection of the armament of various battle-ships will show a tendency of late years to decrease the number of the lighter guns carried. This is not an improvement, and an increase in calibre does not make up for a decrease in the number of shots per minute. It may be necessary, in view of the efficiency of the destroyer type, to increase the number of small guns, even if positions must be selected for them that would prevent them from being used under many circumstances, such as in a rough sea or when the larger guns were being employed—in fact, in positions where they would be used only to repel torpedo-boat attacks.

In torpedo-boats two types are gradually being settled upon by naval powers: the destroyer type and a smaller, slower type with a smaller steaming radius.

There is no settled type of cruiser, and each vessel appears to have been built to fill some pet idea of its designer. What is most essential is a type of vessel that will fill the place of the old sailing frigate and be the eyes of the battle fleet. There are

two special objects to be accomplished by vessels of such a type in connection with the battle fleet. One is to seek information of the enemy's fleet, and the other to mask the movement of their own fleet. The manœuvres of the great naval powers have been somewhat misleading on this question. Each side in the manœuvres has usually had good information as to the composition of the fleet of its opponent, so that a sighting cruiser would be satisfied often with reporting the amount of smoke, and at the most with counting the vessels composing the fleet. Whereas in real war it would be necessary under most circumstances to ascertain something of the real strength of the fleet, and draw sufficiently near to distinguish battle-ships from cruisers. Again, the attacking fleet has seldom used its cruisers as a real mask, but has dispersed them in search of the defending fleet. In real war there is more likelihood of hard fighting than has been shown by the manœuvres, and the ordinary so-called protected cruiser is but poorly fitted for hard fighting; too little room is left for skill, and when two cruisers of approximately equal strength meet in battle, both of them are likely to be lost to their fleets. Some side armor as a protection to their buoyancy is necessary, and yet they should be faster and have a greater steaming radius than a battle-ship. This it has been claimed will lead to excessive displacements and will make the cruisers almost, if not quite, as expensive as battle-ships; but this large displacement has been shown to be unnecessary, although armored cruisers have been enlarged to endeavor to fit them to fight in the line. Something near the ideal type, according to my idea, has been reached in the Argentine armored cruiser San Martin; and I believe such a vessel more nearly represents the frigate of old than any other type of vessel. Here the desired qualities have been secured with a displacement under 7000 tons.

Conclusion.

In what has gone before I have endeavored to show that for purposes of defense alone we must maintain a sea force sufficient to hold command of the sea at certain localities, such as will prevent an enemy from proceeding against our coast or commerce. That the battle which will decide the fate of our coast with its great ports and numerous lines of communication will be fought on the sea and by sea-going battle-ships. That while

our force may not be sufficient to meet the enemy unaided, it should be sufficient to meet him, with reasonable chances of success, when aided by certain coast fortifications located at the advance naval bases. The entire problem of coast defense must be considered as a whole, so that the proper part may be allotted to each kind of force, naval and military, both mobile and immobile. Thus while our battle fleet may be unable to hold its own on the high seas and may be forced to seek the narrow seas adjacent to our coast, that here it may receive such reasonable support as to prevent the enemy from undertaking any important operations, other than seeking to reach conclusions by attacking our fleet at a point selected and fortified by us. With such a force and with judiciously placed fortifications, and a compact but active torpedo flotilla, we should be able to prevent military expeditions from landing on our coast, to prevent the enemy from blockading our ports and to protect our coastwise vessels.

There is no law of strategy by which, if followed, we can hope to protect our interests with a few battle-ships, but there is one, which if we follow will enable us to make a strong defense, with a reasonable fleet, against any of the great naval powers without attempting to enter into a race of construction with the nations of Europe. We need many carefully placed fortifications to aid the fleet, but unless judiciously armed and the locations properly selected our coast and harbor fortifications may become more expensive and less efficient than if all the money were devoted to floating defenses.

Already our interests are closely bound up with the other countries of the Western Hemisphere, and it requires no prophet to foretell that our merchant fleets will once again visit all portions of the globe. So that our interests are now growing beyond the waters washing our coasts, and our Navy will soon be expected to afford protection to a considerable merchant marine in all parts of the world. To do this effectively we must have, also, coaling stations so protected as to defy raiders. In fact we cannot avoid our responsibilities as one of the family of nations. We can avoid entangling alliance and should refrain from assuming the attitude of an armed ruffian, but if we are to remain prosperous and if we are to conserve our liberties we must become powerful, daring to do right and only fearing to do wrong.

Avoiding aggressive war, but not so dreading war as to invite aggression from the armed bully, or so fearing to assert the truth and to stand up for justice as to drift into an armed conflict that might have been prevented by an assertion of our strength in the outset.

> What boots it at one gate to make defense,
> And at another to let in the foe?

(*Discussion, p. 127.*)

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A GENERAL DESCRIPTION OF THE WHITEHEAD TORPEDO,

5 meter, 45 centimeter, Mark I.

With a brief summary of its preparation, on board ship, for a run.

By W. J. SEARS, Lieutenant, U. S. Navy.

Weight of torpedo, ready for discharge (about)	1160 lbs.
Weight of wet gun-cotton (approximately)	220 lbs.
Length of torpedo (5 meters)	16 ft. 5 in.
Greatest diameter (45 centimeters)	17.7 in.
Speed (about)	28 knots.
Range (at 28 knots speed) about	850 yards.
Capacity of air flask	9.9 cubic feet.
Weight of air charge (at 62° F. and 1350 lbs. pressure per square inch)	69.19 lbs.
Reserve buoyancy in sea-water, specific gravity 1.026, at 62° F., about	½ lb.
Weight of Obry gear	8 lbs. 6 oz.

The Whitehead torpedo is built chiefly of steel, and is nearly in the shape of a porpoise. It has a blunt, phosphor-bronze head, and is made in five sections, but dismounted and assembled in four principal parts; the head, air flask and immersion chamber, after body, and tail, all fitted together with sleeve joints, and held together by joint screws. The motive power of the torpedo is compressed air. It is propelled by two two-bladed screws, revolving about the same axis in opposite directions, in order to neutralize their individual tendencies to cause the torpedo to roll. The

after propeller is keyed to the main shaft, and the forward propeller to a sleeve or hollow shaft, free to move on the main shaft. By means of bevel gears on the main shaft, and on the forward end of the sleeve, suitably arranged, the propellers revolve in opposite directions.

The torpedo is maintained at constant depth by horizontal rudders, and on a straight course by vertical vanes set at an angle predetermined by experiment, or by movable vertical rudders controlled by the Obry gear.

These torpedoes are a decided improvement, in the matter of speed and certainty of work, on the earlier type of shorter torpedoes.

The *war head*, of sheet phosphor-bronze, is charged with approximately 220 pounds of wet gun-cotton, and is closed at its base by a bronze bulkhead. In the bulkhead is a moisture tap, through which distilled water may be poured when necessary to make up possible loss of weight by evaporation.

Soldered in the forward end of the war head is the primer case, of brass, in which is inserted the dry gun-cotton primer.

The wet gun-cotton is inserted in a series of discs, a sufficient number of them, counting from forward, being pierced through their centers to receive the primer.

The primer consists of a series of small cylinders of dry gun-cotton in a metal case. The forward cylinder is pierced to receive the detonating primer, containing fulminate of mercury, and capped with a percussion cap.

The *exercise head*, of steel, is ballasted for exercise by filling it with fresh water.

The *war nose* screws into the forward end of the primer case. A traveling sleeve has a thread cut inside, throughout its length, and in this thread works a traveling nut. This nut is turned by a screw fan, receiving its motion by its passage through the water. The nut is screwed back by the action of the fan until it rests against the firing pin. A shearing pin holds the latter in place, and as the nut continues to revolve the sleeve moves out, carrying the fan with it, until the square shaft of the fan is pushed out clear of the nut. The fan then revolves freely. When the torpedo strikes the target, the fan, nut and sleeve are driven in, shearing the shearing pin and driving the firing pin against the percussion cap.

The *air flask* is a hollow, forged steel cylinder, slightly tapered at the ends, with dome-shaped heads screwed and soldered in each end. A strengthening band, left on the inside surface in boring, is tapped from the outside for three screws for attaching the guide stud. Over a hole in the after head is bolted and soldered the body of the charging and stop valves.

Immersion Chamber.—This chamber contains the immersion regulators. It is just abaft the air flask and is riveted and soldered to it. The after end is closed by a bronze bulkhead.

The purpose of the mechanism in this chamber is to control the horizontal rudders after launching, so as to bring the torpedo to a predetermined immersion, and keep it there during its flight. This is accomplished as follows:

A small compartment in rear of the immersion chamber has free communication with the water outside through several apertures in its walls. The pressure of the water, due to depth below the surface, acts against a piston, but the water is prevented from getting behind the piston by a circular diaphragm of thin rubber. The motion of this piston, due to different pressures at varying depths, is communicated to the horizontal rudders by means of rods in such a manner that when the torpedo is below its plane of immersion the increased pressure will elevate the rudders, and when it is above, the decreased pressure will depress them.

When the torpedo is in its plane of immersion the piston is kept in mid-position by an equilibrium between the pressure of the water and the tension of a spiral compression spring.

Hydrostatic Piston Testing Attachment.—This attachment is for the purpose of testing the action of the hydrostatic piston on the rudder. It obviates the necessity of the bent lever used with the 3.55 m.-45 cm., Mark I, torpedoes.

It consists of a composition jews-harp link encircling the tube of the hydrostatic piston spring, and fitted at its upper extremity with a collar that fits over the end of the socket post, under the adjusting nut. The lower end of the link is fitted with jaws, by which it is attached to the horizontal arm of a small bell crank lever pivoted on the bulkhead under the tube of the hydrostatic piston spring. The upper arm of the bell crank is connected to the hydrostatic piston by a ball and socket joint. When the adjusting screw is turned by the wrench in the direction that releases the tension of the hydrostatic piston spring, the adjusting

nut travels downward, bears upon the jews-harp link, and through the bell crank lever forces the hydrostatic piston forward its full travel.

Pendulum.—A pendulum, which swings in a vertical plane passing through the axis of the torpedo, acts to maintain the torpedo in a horizontal plane. If the hydrostatic piston is acting on the rudder to steer the torpedo up or down, when the torpedo has inclined three degrees above or below the horizontal plane the pendulum swings towards the end of the torpedo that is lowest and counteracts the action of the piston on the rudder. The combined action of the piston and pendulum is transmitted by a system of levers and connecting rods to the steering engine, and thence to the rudder, to maintain the torpedo in the horizontal plane at the set depth.

Engine Room.—Next abaft the immersion chamber comes the after body, containing two compartments; between them is a bulkhead. The joint is made tight by a rubber gasket. To this bulkhead the propelling machinery is secured. The engine room contains the main engine and oil cup, the valve group, the sinking and retarding gear, the steering engine, and the locking gear.

The *Whitehead torpedo engine* consists of three cylinders, fixed radially about the propeller shaft with their axes 120 degrees apart. Within the circular enclosure, at the junction of the cylinders, the main crank is free to revolve, and receives its impulse from the piston of each cylinder in succession. The compressed air is admitted behind the piston and evacuated in proper order by means of three slide valves, each working in a separate chest on the forward face of each cylinder, but all regulated by a single cam, keyed to the main shaft.

The Depth Index.—The depth at which a torpedo runs is adjusted by means of the depth index.

An adjusting screw, with a square socket in its upper end, is supported at its lower end in a socket post. A nut travels along the thread of the adjusting screw when turned. A fork at one end of a bell crank presses against a collar on this nut, and a fork at the other end against a compression spring acting against the hydrostatic piston. The lower end of the spindle of the depth index fits in the square socket of the adjusting screw, and has a square socket in its upper end, in which fits a male socket wrench, used in setting the depth index. The spindle carries a worm

which gears into a vertical wheel having graduations around a part of its circumference for 5, 10, 15 and 20 feet immersion. A cap screws down over the worm wheel, having a central hole through which the figures may be seen when the worm wheel revolves. A smaller cap screws down (using a square male socket wrench) over the spindle of the index, to keep it in place and to prevent water from entering the immersion chamber.

The desired immersion, in feet, will be obtained by turning the depth index spindle, with the socket wrench, until the figure indicating this immersion is seen on the worm wheel through the central hole in the cap over the wheel.

The *steering engine* is operated by air at the working pressure of the main engine, and transmits the action of the immersion mechanism to the rudder.

The combined action of the pendulum and hydrostatic piston is transmitted by a rod to the steering engine valve, which controls the action of the steering engine, and thence the position of the horizontal rudder.

There is no valve star used in this torpedo with the steering engine. One arm of the bell crank is pivoted to the forward end of the valve stem of the steering engine, the other arm pointing forward. A rod, connecting with the hydrostatic piston and pendulum, is connected with one arm of another bell crank, the other arm of which points aft and is pivoted to the elbow of the bell crank pivoted to the valve stem. A screw (called the valve adjusting screw), with a square head, passes through a collar in the forward end of the after bell crank, its end screwing in the forward arm of the forward bell crank. A spring around this screw tends to keep the forward ends of the bell cranks apart. Screwing down on the adjusting screw compresses the spring, brings the two forward arms of the bell cranks closer together, practically lengthens the valve stem, and puts the rudder down. Turning the valve adjusting screw in the opposite direction shortens the valve stem and puts the rudder up.

The valve adjusting screw is usually set to give one more division of down-rudder than of up-rudder, to give plenty of scope of down-rudder to steer the torpedo down, as it becomes lighter, on account of the air being used to propel the torpedo. The divisions are marked on the face of a vertical scale which fits, by a collar, over the hollow propeller shaft, and, by a slot, to the

The flat ring (with two small holes in its surface) next to, and just inside of, the setting bar, is the setting bar clamp nut.

When the rudder is locked the valve stem is held rigidly by a long locking arm projecting from a ring, called the locking ring. A shorter arm projects from the opposite side of the ring, and is called the short locking arm. The two arms bear against the face of a flat, circular flange (called the locking flange), cast on a long sleeve (called the flange sleeve), which fits over a rigid spindle. The ring is pivoted midway between the arms on screws which screw into the locking ring carrier. This is a thick cylinder, underneath the locking flange, which slides on a rigid spindle. A circular score is cut in the face of one end of the cylinder, in which a pin, rigidly attached to the locking flange, moves, and thus limits the motion of rotation of the flange around the spindle. The face of the other end of the cylinder has a segmental score planed out, which is the bearing surface on the cam on one end of the rudder index dial sleeve.

The flange is cut away in two diametrically opposite sectors, each sector being about one-sixth of the circumference of the flange, and cut deep enough towards the center to permit fore and aft motion of the arms of the locking ring, when the locking sleeve and flange are revolved to the proper position.

The flange and its sleeve also slide on the same spindle as the locking ring carrier, the flange and carrier being held to position by a spring (around the spindle and inside the sleeve). Next to the spring is a washer, and next to the washer the ratchet bar sector arm; all held in position on the spindle by a nut screwed on it next to the ratchet bar sector arm. This arm pivots around the spindle, and supports the sector, of which it is part. Two deep slots are cut in the flange sleeve (diametrically opposite), and the ratchet bar sector arm fits in these slots snugly so that the motion transmitted by the ratchet bar to the ratchet bar sector is transmitted by the latter to the flange sleeve and flange, to release the locking ring, and thus release the steering engine valve rod to action.

In locking the rudder the bevel gear is turned by a wrench, with its two pins inserted in the slots of the sleeve. This draws the ratchet bar down. Its teeth engage with those of a small pinion. This pinion receives a motion of rotation from the engine when running, moves the ratchet bar up again, turns the

locking sleeve until the arms from the ring are opposite the cut out portions of its rim, when the valve stem is unlocked, and the steering engine free to act.

Rudder Index.—This regulates the position (up, down, or horizontal) in which the rudder is locked during the time the locking gear is in action. This regulates the depth of the initial dive of the torpedo.

The dial of the rudder index is on the left side of the torpedo. It is circular and graduated to 32 divisions on each side of the zero mark, and is turned by a wrench. It is clamped by the inner clamp at the center of the index, the outer clamp being for the locking dial.

The dial is on the face of a long sleeve, the other face of which is a cam, bearing against a sleeve (called the rocking ring carrier) on which pivots the locking ring, with two arms.

The valve stem of the steering engine being locked by the locking gear, when the dial of the rudder index is revolved with a wrench, the valve stem is moved out or in, by the cam on the rudder index dial sleeve moving the locking ring carrier, and with it the locking ring, the long arm of which moves the valve stem. Turning the dial to the right puts the rudder down, and to the left puts it up. Briefly, the rule is, *the rudder moves in the same direction that the dial is turned.*

Obry Gear.—The object of the Obry gear is to keep the torpedo on a straight course during a run.

It is carried in the after compartment of the after body, just abaft the bulkhead to which the main engine is secured. It is put in place, and may be removed, through a door in the shell of the torpedo on the under side. Its frame is secured by square-headed screws to supports riveted to the shell of the torpedo.

The Obry consists, essentially, of a gyroscope controlling the motion of the valves of a steering engine, which operates two rigidly connected, vertical rudders, working in the forward top and bottom blades of the torpedo.

The gyroscope wheel, of Tobin bronze, is three inches in diameter and weighs 1¾ lbs. Its axis is in a fore and aft direction in the torpedo. The axle is fitted with tool steel female centers, supported on male centers screwed through the inner ring. The inner and outer rings are fitted with steel female centers and supported by screws the inner ends of which form the male centers.

OBRY GEAR AND ADJUSTING STAND.

1. Gyroscope wheel.
2. Male centers.
3. Inner ring.
4. Outer ring.
5. Locking screws.
6. After centering screw.
7. Nut.
8. Jamb nut.
7 and 8. Counterbalance.
9. Pin for valve arm.
10. Valve arm.
11. Rolling valve.
12. Steering engine.
13. Valve plug.
14. Adjusting screws.
15. Impulse spring.
16. Impulse sector.
17. Adjusting stand.
18. Holding-down screws.
19. Cylinder head.
20. Clutch.
21. Vertical rock-shaft.
22. Horizontal rock-shaft.
23. Double-acting rock-shaft spring.
24. Auxiliary rock-shaft spring.
25. Holding-down springs.
26. Holding-down plate.
27. Holding-down studs.
28. Holding-down nuts.
29. Air-cushion cylinder.
30. Impulse sector stop.
31. Socket for winding key.

Try hydrostatic piston to get the throw of horizontal rudder due to the action of the piston alone.

To do this see the yoke on, level torpedo, give two or three turns to regulator, raise water tripper, raise starting lever; then work depth index with a socket wrench, screwing it up and down between graduations 0 and 5. This will give a *total* throw of the rudder of from 3¼ to 4½ divisions, and in all cases should give ¼ division more down-rudder than up-rudder. In case it does not give this much more down-rudder, lengthen the steering engine valve rod by turning the valve adjusting screw to the right, by means of a small wrench inserted through a hole in the shell of the after body, just forward of the locking dial.

This adjustment is important, and if it cannot be made by the valve adjusting screw, the steering engine rod will have to be lengthened or shortened (depending upon whether down- or up-rudder is required to give the ¼ division more down-rudder desired), by screwing the steering engine rod out or into the coupling just abaft the steering engine.

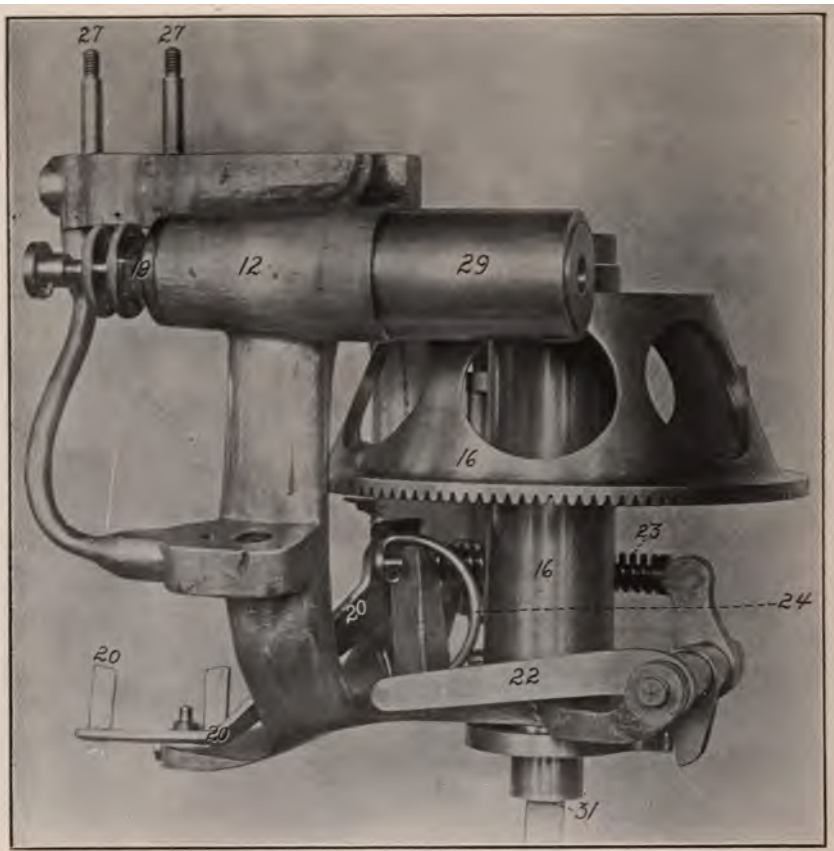
Try Steering Engine.—To do this admit air to steering engine by lifting the starting lever slightly. Insert a small socket wrench through hole in shell of torpedo, place its end over the end of the valve adjusting screw, and move the steering valve rod as far forward, and then as far aft, as possible. This should give four divisions down-rudder and three up-rudder.

Set distance gear by means of socket wrench inserted through a hole in the engine-room door, fitting over the square upper end of the adjusting spindle. The record sheet gives the setting for 800 yards range. See that the friction cam pin bears against the distance sector stud.

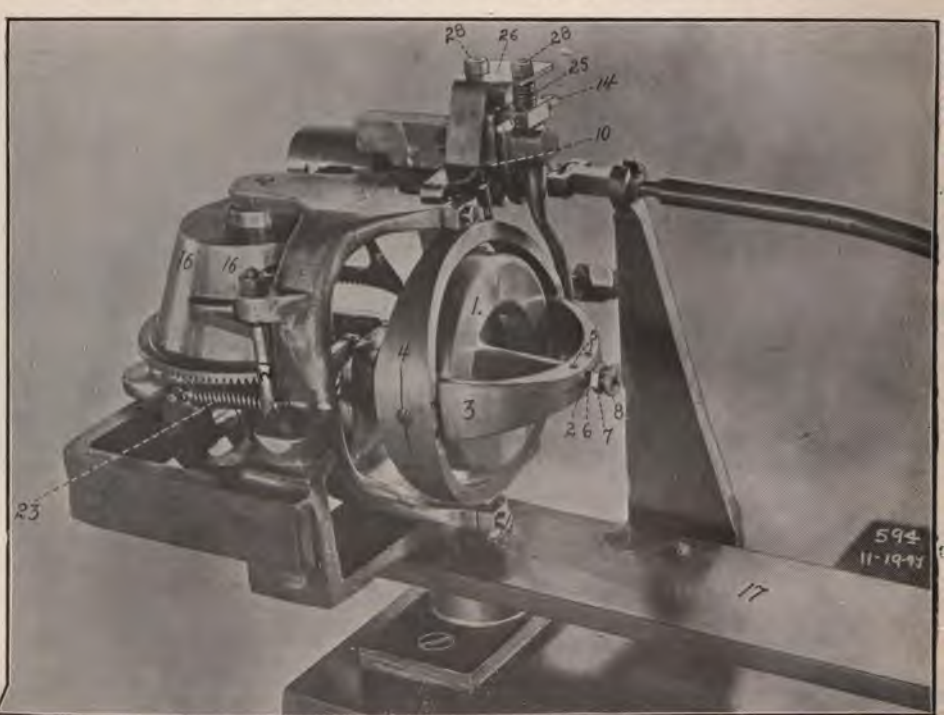
Set the Regulator.—Insert the crank with a square head in the square socket of the head of the regulator plug. Screw the plug up until its upper face is flush with the top of the regulator body. The record sheet gives the number of turns to be given to the plug to obtain maximum speed for an 800 yard run.

To get the best speed of the torpedo the pressure in the air flask should be reduced from 100 to 105 lbs. per 100 yards run. If enough air is not used to reduce the pressure this amount, screw the regulator plug down a little more.

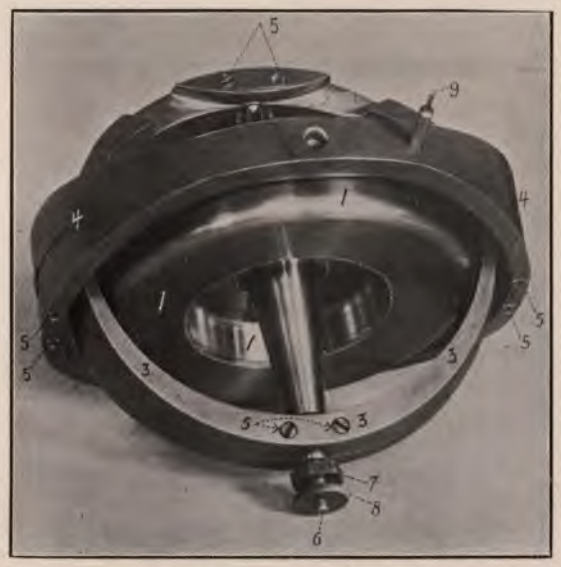
The final pressure in the air flask after a run is obtained by unscrewing the charging valve plug and screwing the valve end



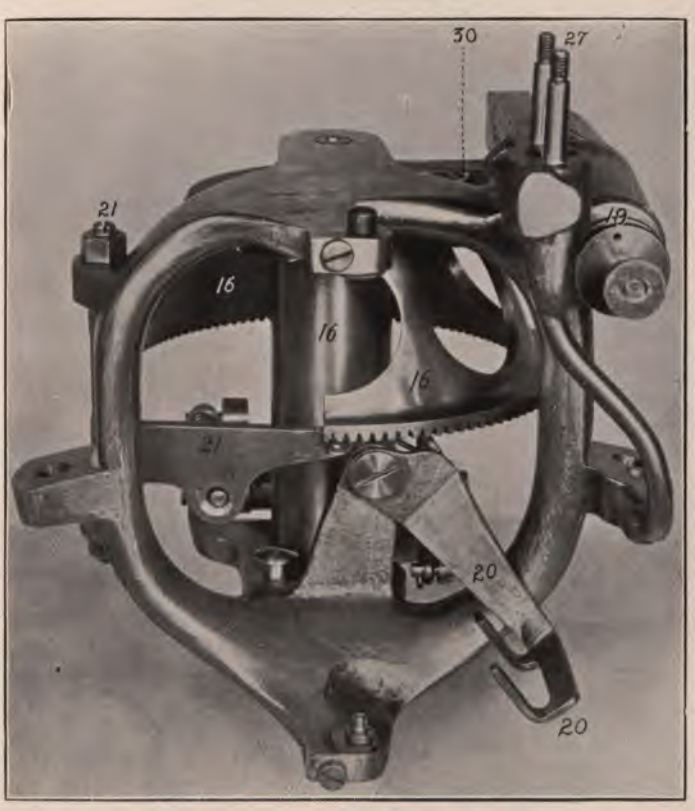
OBRY GEAR--Gyroscope Wheel, Rings, Impulse Sector Spring and Rolling-Valve Dismounted.



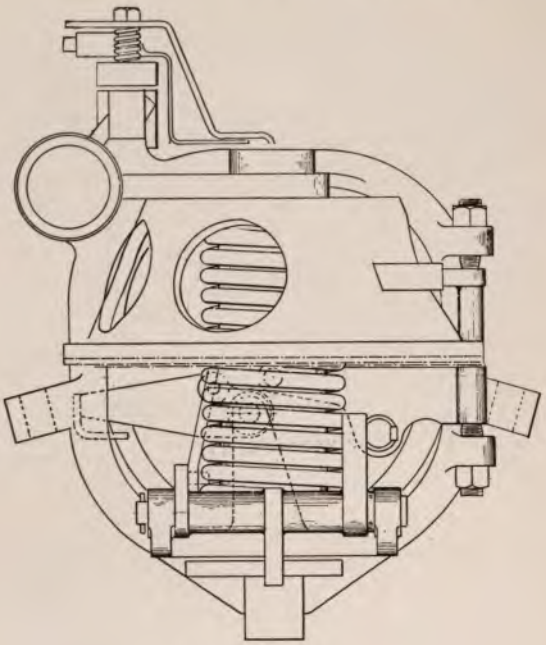
OBRY GEAR ON ADJUSTING STAND.



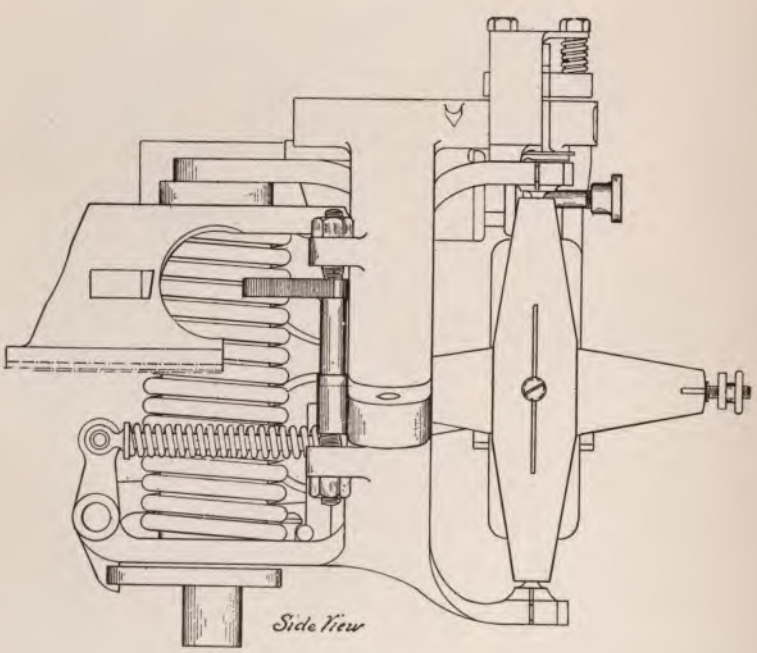
GYROSCOPE WHEEL, with Inner and Outer Rings, Counterbalance, Pin for Valve-Arm, and Clamp Screws.



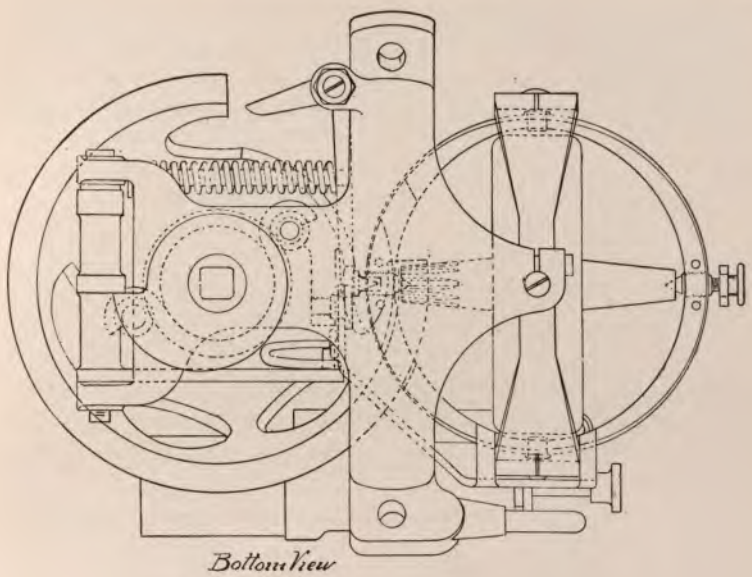
OBRY GEAR--Wheel and Rings Dismounted; also Impulse Spring and Rolling-Valve Removed.



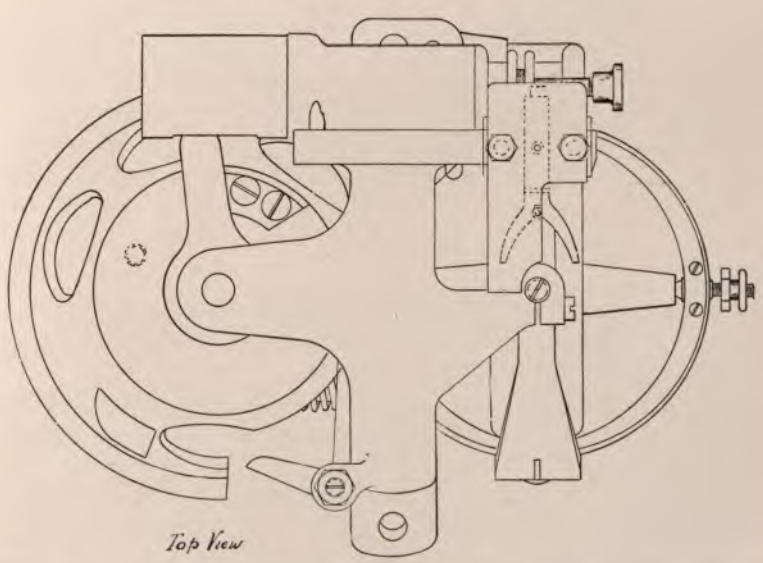
Forward End View



Side View



Bottom View



Top View

When the wheel and rings have been adjusted these screws are locked by locking screws. The after centering screw of the axle of the gyroscope wheel projects beyond the inner ring, is

be more readily examined and kept free from rust, if the wheel is kept dismounted and in the compartment provided for it in the Obry gear box. The wheel should always be dismounted for transportation. To dismount it come up the clamp screws of the counterbalance centers, but do not disturb the other center of the wheel, in order that the wheel may be put back in the same position in the ring.

Jam the two nuts of the counterbalance tightly together, holding the hexagonal-headed nut with a wrench, and screwing the jam nut tightly against it with the fingers. Then grasp both nuts with the thumb and forefinger, and by turning them to the left (and with them the center on which they are screwed) the center will screw out until clear of the axle of the gyroscope wheel, when it may be removed.

Impulse Spring.—Should the impulse spring become weak, tauten it up as follows: Take out the screws in the impulse sector stop, and take off the stop. Give the impulse spring one complete turn with the winding key, and holding it in this position by the key, put on the stop again. Be careful to keep the fingers out of the holes through the impulse sector or they might be cut off by the sector in case the key should slip.

To Assemble the Obry Gear.—Clean out steering engine cylinder with clean, oily waste.

Put in cylinder head between steering engine and air cushion cylinders, and set it up tightly, using winding key inserted through steering engine cylinder.

Oil piston and piston rod of steering engine and put them in.

See that the packing of the stuffing box of the steering engine is in good order and in place. For packing use a piece of 2 strand lamp wicking, about nine inches long, dipped in best tallow.

Use an oiled linen paper washer under both cylinder heads.

Screw the outer cylinder head in tightly with flat open-end hexagonal $\frac{1}{4}\frac{7}{2}$ inch wrench provided.

Set up on the stuffing box with thumb nut, so that the piston works moderately tight.

Put in the split pin holding the bonnet of the stuffing box from turning.

Put in the air cushion pistons, the one with the screw hole in it being outboard.

Put the cushion lever on the impulse sector.

Put the impulse sector in place, and insert its shaft to see that they fit properly.

Put on the impulse sector stop.

Take out the shaft, and put on the impulse spring.

Put in screws holding the end of the impulse spring.

Put sector and spring in place in frame, and put in impulse sector shaft.

Secure ends of spring to screws.

See that the impulse sector stop is on the right side of the lever for cushion piston.

Screw the outer ring centers in place until they are just through the frame.

Secure inner ring in outer one by its centers, balancing it neatly.

Put rings in frame and screw in outer ring centers.

Put in the centering lever or clutch.

Put in vertical rock shaft for centering gyroscope wheel.

Put gyroscope in rings, balancing it neatly.

Insert a block of wood about an inch and one-half thick between the impulse sector and frame, to bring the sector into position to mesh with the teeth on the axle of the gyroscope wheel.

Turn up the clutch of the position holder by hand until it bears against the inner ring, to get the rings at right angles to each other. Then move the vertical rock shaft bodily up or down as necessary, by means of the screws at its ends, until the centering stud enters the socket in the end of the gyroscope wheel. When in the right position, lock the rock shaft against vertical motion by setting up the locking nuts at the ends of the shaft.

Examine the meshing of the impulse sector and teeth on the axle of the gyroscope wheel, to see that it is done satisfactorily, and see that the clutch brings up against the inner ring, to bring it in proper position for the centering pin on the vertical rock shaft to enter the socket in the center of the gyroscope wheel.

Put in the clamp screws of the outer ring centers.

Put in the horizontal rock shaft, the double-acting rock shaft spring and shaft, and the split pin in the end of the shaft.

Hook up the auxiliary horizontal rock shaft spring (a piece of brass wire) and put in split pin.

Clean rolling valve with oily waste, and wash it off with a blast of air from the charging pipe.

Put in the valve plug, put on the valve arm, holding down springs, holding down plate and nuts. Put in the valve arm holding screw, seeing that the valve is on the center, with the valve arm in mid-position, before setting up the screw tightly.

TOOLS USED WITH OBRY GEAR, WITH THE NAMES, DIMENSIONS, AND USES OF EACH TOOL.

Tool No. 1.

Name.—Flat, open-end wrench (double).
Use.—(Hexagonal end, 5/16 inch) with hexagonal-headed nuts, holding down valve-guard plate on top of valve.
Use.—(Square end, 9/64 inch) with valve-plug adjusting screws, and securing screw of valve arm.

Tool No. 2.

Name.—Flat, open-end wrench (double).
Use.—(Hexagonal end, 3/8 inch) with check nuts of vertical rock-shaft pivots.
Use.—(Hexagonal end, 17/32 inch) with cylinder head of steering engine.

Tool No. 3.

Name.—Small screw-driver (double end).
Use.—(1/8 inch end) with inner ring clamping screws, and clamping screws of gyroscope wheel pivots.
Use.—(3/16 inch end) with all pivots of gyroscope, and rock-shaft pivots.

Tool No. 4.

Name.—Small screw-driver (double end).
Use.—(1/4 inch end) with door-plate screws and frame pivot locking screws.
Use.—(5/16 inch end) with screws for stop on impulse sector.

Tool No. 5.

Name.—Combination winding key and socket wrench.
Use.—Winding key (square head, male, 11/32 inch, one foot long, stem 6 inches long) winds up Obry; also screws (in or out) the partition between the steering engine and air-cushion cylinders, by inserting wrench (through steering-engine cylinder) in square socket of partition. (This partition forms a cylinder head common to both steering engine and air-cushion cylinders.)
Use.—(Square socket wrench, female, 7/32 inch) with holding screws of Obry, securing it to its supports in the torpedo, or box.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SOME PRACTICAL NOTES ON BATTLESHIPS.

From a seaman's practical standpoint, *i. e.*, as seen by "the man behind the gun."

By Lieutenant E. W. EBERLE, U. S. Navy.

Our battleships of the Oregon class were designed, built and given their trials on a theoretical draft of twenty-four feet: a draft which has no practical significance and upon which they have never gone to sea since being commissioned. With her coal, stores and peace-time supply of ammunition on board, and ready for a cruise, the Oregon has a draft of more than twenty-six feet, displacing more than 11,500 tons, and her armor belt is very little above water. Thus when ready for sea, with the main armor belt submerged, these battleships are very little better off in the way of above-water protection than armored cruisers, their only protection above water being the four-inch armor belt. Granting that these ships could go into action with very little coal in the bunkers so as to get the full benefit of the armor belt, and in comparatively smooth water, even then a few shot holes at the water line forward and abaft the armor belt would soon fill enough water-tight compartments to cause the ship either to turn over or to heel to such an alarming extent as to interfere with the working of the guns and to submerge the armor belt completely. As the all-important object is to keep the ship on an even keel so as to fight the guns most effectively, it would seem far better to allow the ship to settle steadily in the water until the main armor belt is entirely submerged, rather than to have her heel to an alarming extent; and for this reason, in these ships, I think that all unprotected water-tight compartments at the water line, forward and abaft the armor, should

extend the entire width of the ship in order to prevent the ship "heeling" when they are caused to fill through shot holes. It requires about forty tons to increase the draft one inch in these ship when at their normal displacement, and consequently it would not take a very large compartment of water to completely submerge the armor belt when on an even keel, and thus our battleship is again reduced to the level of an armored cruiser, even when she started out with very little coal in her bunkers. For these reasons I am decidedly opposed to the dangerous theory of partial armor belts, which leave both ends of a ship entirely unprotected; and, as I said before, a few shot holes at the water line of these unarmored ends would soon admit sufficient water to put the main armor so far below water as to be of no use; and a few more shot through the four-inch armor, which would now be the only water-line protection, would soon admit enough water above the armored deck to cause the ship to turn over or to put the heavy guns out of action by the angle of heel. In my opinion, it would be much better to have a lighter and wider armor belt extending from stem to stern than a partial armor belt of great thickness. In our new ships we have advanced one step by extending the armor belt to the bow, but the after-part of the ship remains unprotected by side armor; however, in our future ships we may have the pleasure of seeing a complete fore and aft belt of armor protection and more freeboard; and then we can truly say that we have built an ideal battleship—one that can fight when in cruising trim, and one that cannot be reduced to the level of an armored cruiser by the striking of a few shell at the water line of the unarmored ends.

Spare Articles.

The argument always advanced against a complete armor belt is that these ships, on their present displacement, cannot carry the weight at that height; but why not dispense with various weights that we now find on board our battleships and which have nothing to do with the *fighting qualities* of the ships? Our ships are entirely too complicated and have too many encumbrances for fighting machines. Walk through a battleship when she is cleared for action and note the hundreds of articles that are struck below on account of not being a part of the fighting outfit, and see the many things marked "overboard" on account

of belonging to the *peace equipment*. These are the articles that complicate and encumber our battleships and take the place of weight that should be given to *armor* for the unprotected ends of the ship. It is impossible to obtain the most efficient results if we design a fighting ship with the idea of fitting her with both a *peace equipment* and a *war equipment*: and I firmly believe that every battleship should be always kept in fighting trim—even to the color of the paint—and that all superfluous articles should be sent on shore.

Stores and Equipment.

I cannot see why battleships should be supplied with everything in the way of stores and equipment that are supplied to cruisers when fitting out for a three years' foreign cruise. Our battleships are principally for home defense and their radius of cruising is limited by our coaling stations; therefore, why not limit their outfit of stores and supplies to a certain extent—say six or eight months—and thus do away with the great weight due to over-abundance of stores, which weight should be given to *more ammunition* and to *armor* for the unarmored ends. There is no reasonable argument for filling the store-rooms of our battleships with from two to three years' stores when their coal capacity limits them to twenty-four days' steaming at the outside. Each one of our battleships is burdened with enough spare articles and enough needless stores to fit out another ship of the same class in time of war. If, in war times, our battleships are to remain on our own coast on the defensive, then they are at the very base of supplies, and they can be kept filled up with coal and stores; if they are sent to the enemy's coast to act on the offensive, they must necessarily be accompanied by coal-laden steamers; so why not at the same time have them accompanied by supply ships? Every fleet of heavy ships should have its fast colliers and supply steamers, and then battleships could dispense with the present plan of carrying large quantities of stores and spare articles, the weight of which tends to sacrifice an ample ammunition supply and prevent more side armor.

Torpedoes.

Next, let us gain weight by doing away with torpedoes in battleships, for are they not entirely out of place in battleships,

in armored cruisers, and in large vessels designed as scouts? I cannot imagine any circumstance under which a battleship would dare use her torpedoes, unless it would be to give the "knock-out blow" to an already defeated and disabled enemy before he could lower his colors; and it would seem poor judgment to approach within torpedo range of an enemy that is already whipped, because *he* might possibly have an uninjured torpedo tube and that would put both vessels upon an equal footing again, thus possibly throwing away the victory that previously had been won. Cruisers will use their high speed to avoid engagements with battleships, and therefore battleships will in most cases be opposed by battleships or armored cruisers. In such engagements the battleships would probably never be within torpedo range of each other, and if by chance they should close to 800 yards, would any commander dare open his broadside torpedo ports and attach the war-head in the face of the terrific fire of his opponent's numerous rapid-fire guns?

A better target for rapid-fire guns at 800 yards than an open torpedo port in the armored side of a battleship could hardly be desired; and if the "men behind the guns" fail to explode the air-flask or war-head, they would most certainly destroy the tube itself. The Oregon has a bow tube, a stern tube, two starboard broadside tubes, and one port broadside tube—all above water. Her bow and stern tubes are fixed, and as they are not protected by armor, they may as well be eliminated from the discussion. The broadside training tubes are behind four inches of armor, which offers little protection against the main battery of a battleship. Besides, the broadside tubes could not be opened except in smooth water; the bow tube could never be used when under way excepting at very slow speed, a speed at which the Oregon's helm is of so little use that she must be handled with her engines. It is claimed from experiment that war-heads will not explode when struck by rapid-fire shell unless the small detonater itself is struck; but would any commander of a battleship be willing to stake the fate of his ship in battle upon this assumption, merely for the sake of obtaining a chance shot at the enemy, provided his tube and air flask have not already been penetrated? I do not believe that any commander would so menace his own ship, when in action, as to open his torpedo ports and attach the war-heads as long as he could fight a single gun. If every gun

has been silenced and the enemy should be so indiscreet as to approach within short range, then a torpedo might possibly prove successful against him; but when a ship has been so seriously battered as to have every gun disabled it is hardly possible that her torpedo tubes remain uninjured behind only four inches of armor, not to mention what would occur when the torpedo ports are opened and the tubes exposed to fire. In my humble opinion, torpedoes in battleships, in armored cruisers, and in scouts, are out of place and are a menace to the ship that carries them; and I believe that in the near future our policy will be: *Torpedoes in torpedo vessels and in nothing else.* However, if we *must* have torpedo tubes in our battleships, let them be submerged. I consider that the appropriation for each battleship or armored cruiser should contain a provision for two torpedo-boat destroyers. These two "destroyers" should attend the battleship during all manœuvres, and in time of hostilities they should serve as her "faithful watchdogs" at night, being always on the alert for torpedo-boats and rams. The service that these "destroyers" could render a fleet of fighting ships would prove most valuable: some on the scout and others on the lookout. They could form an inner picket line for the fleet, the outer line being formed by the large cruising scouts. How much more secure and comfortable the fighting ships would feel, when on the blockade or when approaching the enemy's coast, if each had two effective torpedo-boat destroyers to insure protection from the ever-dreaded little "night prowling" torpedo-boats. The two "destroyers" should be a "part and parcel" of the battleship and under the orders of her commanding officer; and they should look to the "mother ship" for all supplies when cruising and also for protection from the enemy's fighting ships. During action they could possibly find shelter under the unengaged side of their powerful protector and be ever ready to dart forth to repel the onslaught of torpedo-boats. Thus, for protection against the enemy's torpedo-boats, the fleet should rely upon *its own "destroyers,"* and not upon useless torpedo-nets.

Boats.

Why should a battleship be burdened with *fourteen boats?* Why not do away with some of these weights which are carried so high? Then we could also dispense with two of the four

gun will give a good account of itself, and our terrific broadsides will bring us victories as they have in the past.

Complement.

Our battleships have not enough officers and men to fight the guns efficiently, to supply ammunition rapidly, and to form a reserve force for filling vacancies.

In naval warfare between first-class powers, the one that can fight the greatest number of guns and men throughout the action will be victorious; and therefore the first consideration should be given to supplying ships with large crews and with as many guns as can be carried. Consideration should also be given to protecting the men and the guns by armor in order to retain their services as long as possible. In battle the prime object is to kill as many men as possible, thus silencing the enemy's guns by depriving them of their crews. No matter how riddled and battered a ship may become, as long as she floats and guns remain intact the men will fight desperately, so it follows that the men must be killed, the guns dismounted, or the ship sunk in order to insure victory, and the easiest plan is to kill.

When battleships of the Oregon type engage other battleships it would be simple slaughter to keep the crews of the 6-in. and 6-pdr. guns at their exposed stations when at long range, and I believe that a wise commander would send the crews of these unprotected guns to seek shelter below behind armor, and thus have them ready to fill vacancies in the crews of the heavy turret guns and to man their own guns when at close, effective range. It will be absolutely necessary to have a *reserve force* of men in well protected places below for the purpose of filling vacancies as they occur at the guns.

If the 6-pdr. crews are kept at their guns from the beginning of an engagement, I fear that none of them will be alive to fight their guns when they become of use at short range. If the opposing battleships have their heavy guns mounted *en barbette* and not in covered turrets, or when engaging cruisers with their exposed gun crews, then it would be necessary to fight the 6-in. and 6-pdr. guns when within moderate range; but otherwise it would be folly to allow those gun crews to remain at their exposed stations as a target for the enemy's heavy guns at long range. Our heavy guns behind thick armor are the ones that

sition of a *landsman*, who recently visited this ship, was amusing. The landsman asked why the ship carried so many boats, and he was told that they were required to be able to carry all the men in the event of abandoning ship. He then asked how we would get the boats in the water, and he was answered that they were supposed to be hoisted out at sea by the cranes, but that the success of the undertaking would be in doubt. Our landsman thought for a moment, and then his face brightened as he conceived a *brilliant nautical idea*, and he said, "If the ship is sinking, why not leave the boats in their cradles and put the men in them, then get the oars ready, and when the ship goes down and the boats float, *pull away* like thunder!" I fear that an attempt to get the boats out at sea with our boat cranes would come near meeting with the same fate as the "hayseed" proposition of our innocent landsman. We must give up the idea of having to abandon ship at sea, for it would be impossible to hoist out the boats without smashing them to pieces; but if successfully launched and filled with the men and the provisions that they are required to carry, they could not live in even a moderate sea. We must look at this matter in a cold practical way and decide to *stand by the ship*, and survive or perish with her, for that is the plain common sense of it. Boats are of very little use at sea to a modern ship, except to rescue a man overboard. In our present age of high-powered twin-screw steamers we have eliminated the anxiety of being "knocked down" or "driven on a lee shore," which were the most frequent misfortunes that compelled the crews of the old-time sailing vessels to take to their boats and "abandon ship." Necessity for abandoning ship at sea at the present day could only be brought about by very severe weather or by a collision. In the former case—a very improbable one for a well built steam vessel—the few davit boats of a man-of-war might possibly get clear of the ship with a few men, but the large boats in the cradles could never be hoisted out during a gale that would imperil the ship, consequently the majority of the crew must stand by the ship and trust to her seaworthiness. In the case of a collision at sea between modern ships their safety would depend upon the rapidity of closing the water-tight compartments, and therefore the crew would have to trust their lives to the good condition and successful working of the water-tight doors. If a collision is so severe

that the water-tight compartments of a modern ship will not keep her afloat, then there will be no time for getting out and provisioning boats. In case a ship is stranded a few boats will do the work of rescue and of getting a line through the surf. In time of war there must be no such thing known to a man-o'-warsman as "abandoning ship"; he must make up his mind to stake his fate with his ship and either cheer her colors in victory or go down with her in defeat.

A battleship's outfit of boats should consist of two large steam cutters capable of carrying sixty men each, two large launches capable of carrying seventy-five men each, two life-boats and two dinghies; the steam cutters to be used for all running and towing purposes, and with the launches to be used for carrying stores or landing an armed force.

I am glad to see that in our new ships the lofty and useless battle-mast is reduced to a mere fighting tower, and therefore we have dispensed with one menace to the fighting qualities of the ship.

Armament.

The most important subjects in battleships are the armament, armor and ammunition supply; and all else, excepting the engineering department, must be sacrificed for these three main fighting qualities.

When the United States Government commenced building a navy the policy was to have her ships armed with *more guns* and with guns of *greater range* than were carried by the war vessels of other nations. That policy was carried out in our early wars, and history records the splendid victories, and these victories were made possible by the large number of long-range guns carried by our ships.

Up to the time of designing the battleships that are now on the stocks, our uninterrupted policy had been to build ships that excelled in battery all foreign ships of the same class, and our Oregon class maintained this policy, as their eight-inch guns far outclass the six-inch guns of foreign battleships. The Kearsarge and Kentucky are somewhat doubtful about maintaining our cherished policy, as many look upon their superimposed turrets with a skeptical eye. However, in our latest battleships we have completely abandoned the policy that we had held to for a century, as these ships are designed to be the *equals* of

foreign battleships in armament, gun for gun, and *not superior* to them. We have abandoned the splendid eight-inch guns which made our Oregon class superior in armament to any ship afloat, and now we have nothing but six-inch guns to back up the thirteen-inch. I think this is a very unwise departure from the policy that always brought us victory in our past wars; and should our Alabama class engage with ships of the same class I fear that the victory would hang in the balance, while it would be insured had our ships been given the eight-inch guns. I consider the forty calibre eight-inch gun a superb piece of ordnance, and one that we can ill afford to dispense with in our battleships, although I do not commend the eight-inch turret mounts in the Oregon class. Those turrets simply invite disaster, as they are perched high in the air, with only a four-inch armored ammunition tube underneath them for protection. These turrets make an excellent target, and one five-inch shell striking and exploding in the armored tube under the barbette would throw the turret and its two eight-inch guns out of action. Why not mount a single eight-inch gun *en barbette on the main deck* at each angle of the superstructure, the barbette being twelve inches thick and carried down to connect with the main armor belt, thus insuring absolute protection for the ammunition, and eliminating the chance of having the eight-inch turret "struck beneath the belt" and being "knocked out"? I would also mount an eight-inch gun *en barbette* on the main deck amidships. This plan would give three eight-inch guns on a broadside with splendid protection, and the weight of the armored barbettes would not exceed the weight of the present turrets. These guns should be worked entirely by hand gearing, and I believe that these three guns on a broadside could deliver more shots within a specified time than the present four guns mounted in two turrets. I would mount two six-inch R. F. guns on the broadside between the eight-inch barbettes, one in each diagonal of the superstructure, well inboard, two on the upper deck amidships, and two under the forecastle—thus having eight six-inch guns in a broadside. Of course, the six-inch guns in the diagonals would have a very limited arc of fire. I would have the upper deck fairly bristling with *twelve-pounders* and *six-pounders*.

The present plan in the British ships of enclosing each six-inch gun by a thick Harveyed steel casemate is an excellent idea.

that healthy criticisms and practical suggestions by the sea-going officers who man our battleships and fight the guns should be very acceptable to those in authority who create our naval policy; and also to those who are intrusted with the noble work of designing and constructing our great national defenders and who have not the opportunity of observing the practical behavior of these ships at sea. With this belief, I have closely observed the behavior of the Oregon under all conditions of sea and weather, and also the practical working of her armament and mechanical appliances; and I have noted them down from time to time in the way they have impressed me from a seaman's practical standpoint, *i. e.* as seen by "the man behind the gun," and if any of my practical suggestions serve to increase the fighting efficiency of one of our ships I shall feel very much gratified.

DISCUSSION.

Discussion of "Our Naval Power."

Commander C. H. Stockton, U. S. N.—It is not my purpose to review the paper of Lieut.-Commander Wainwright as a whole. So much of it is or ought to be accepted as sound that in the main a review would be simply a re-echo of his views. There are a few points, however, which may be well to discuss, in order to elaborate or to present varying rather than antagonistic opinions. It is perhaps natural, but none the less to be regretted, that there should be such diverging views held by officers of the Army and Navy as to their respective rôles in harbor and coast defense, and also in combined operations. The lack of a common defense board or proper general staff in both services aggravates this discordance. Many military officers of high rank in both services seem even at this late day to fail to comprehend the necessity and utility of such an organization, the lack of such comprehension being, to my observation, greater in the Army than in the Navy.

The differentiating of the defense of harbor and of coasts, urged by the writer for years past, as expressed by the essayist, shows plainly the difference between the functions of the Army and Navy upon our sea frontier, and the larger and more comprehensive scope of naval coast defense over that of harbor exclusion and defense. So to my mind the alternative predominance of the Army and Navy is generally lost sight of in the question of combined operations in the attack or defense of a fortified seaport.

The attack or siege is based upon the sea, and to it the command of the sea in those regions is necessary. This free use of the sea gives the life and movement to the attack, the sea is the highway for its communications, its supplies and its reinforcements. In the attack, then, the naval force and command is essential for advance and retreat, and the naval commander-in-chief should have the pre-eminence and command of the combined forces. There should be *unity* rather than *concert* of action.

In the defensive operations the contrary exists. Everything depends and is based upon the land, whether the fort is insular or continental; the command of the sea, without which the attack is impossible, limits to the land territory the source of all supplies and resources. If the mobile forces assisting the fortifications of the fort are sea-going they are by force of circumstances and inferiority localized as auxiliary for defensive purposes; if the auxiliary craft be non-seagoing, such as those likely to be manned by naval volunteers or militia, they are still more secondary in place, and the land forces become the principals and the commander of these land forces naturally the commander-in-chief.

I do not understand the author of the paper to take the ground that the Hawaiian islands are necessary or important to us in the matter of

the defense of our Pacific coast. A group of islands at a distance of more than 2000 miles is neither of assistance for the defense of our home coasts nor of use to an enemy for purposes of attack upon such coast. Its importance, strategical and otherwise, to my mind, is due to its position as a stepping-stone to what is beyond and as a coaling station, with docking facilities, at a crossing of sea highways.

It does not require a separate fleet to defend, as the sea-going fleet that defends our Pacific coast from Attu to San Diego likewise defends the Hawaiian group against the only objective—the enemy's fleet. The distances from the home ports of origin of possible enemies causes a filtering and reduction of available force for offensive purposes to a size which we should be able to readily meet.

Attention has been called, and not improperly, to the fact that the great circle routes between North American ports and the extreme Orient go long distances to the northward of the Hawaiian group. This will be doubtless a factor, as the Alaskan coast and the Aleutian group furnish sufficient ports of trade to attract the cargo or tramp steamer along our own coasts and islands; but such is not the fact now, and few, if any, of the steamers in crossing the Pacific follow the extreme great circle routes.

It is not unfair to suggest the analogy between weather and sea conditions and the topography that dictates routes for armies and railways—the fog, high winds and rough seas of the northern Pacific in practice are related to the rough topographical features of uninhabited regions, and force most of the sea routes, even for steamers, to the southward of the great circle routes to Japan. Neither the Canadian Pacific steamers from Vancouver nor the Pacific mail steamers from San Francisco ever take the extreme great circle route, while the number of steamers that take the longer routes and call at the Hawaiian group is increasing every year.

thread (cut away longitudinally) so that it will not require a large number of turns to send it home. In this gun the breech block slides laterally in a chamber across the breech and the breech screw merely forces it tight against its seat. When the gun has been fired the screw is turned back slightly, releasing the block, which is then pulled out at the side of the gun. The steel tube or sleeve in the breech, which is shown withdrawn in Fig. 2, is then pushed in, as at Fig. 1, and the cartridge is passed through it into the chamber at the rear of the bore, the rim of the flat end of the cartridge projecting slightly outside the rifled tube. The sleeve is then withdrawn and the breech block slid back, a circular recess in its face fitting the flat end of the cartridge. The steel screw is then turned, pressing the breech block tightly against the end of the cartridge and the rifled tube, and thus forming a gas-tight joint. A bolt in the head of the gun engages with a groove in the back of the breech block, and forms a gauge to ensure its being in proper position. The gun is then fired by the lock shown in the end of the breech block, the screw reversed, the breech block slid out, the sleeve pushed in and the cartridge removed.

The gun is the invention of Mr. Edwin J. Blood, of Chicago, and is being handled by the American Sectional Cannon Co., New York Life Building, Chicago, of which Mr. Duane Doty is consulting engineer. The right to manufacture the gun in Europe has, it is stated, been secured by an English company, which sent out military experts to examine the model gun built under the direction of the inventor.

It seems to us that the chief defect in this gun would be its lack of longitudinal stiffness. In the early experiments with wire-wound guns trouble was experienced with the droop of the muzzle until an external jacket was adopted, and we should suppose something of the same sort would be necessary here, unless for very short pieces, such as mortars.—*Iron Age.*

THE DIAMOND SHOAL LIGHTSHIP No. 69.

The lightship here described has now been in position off Cape Hatteras for the last three months and has successfully withstood the heavy gales of the present winter at that dangerous point. The ship is anchored in 30 fathoms of water, and her general performance has been satisfactory to the Light House Board, as tending to show that a lightship can be safely maintained there and serve as a much-needed beacon and warning for mariners.

Both lightships, Nos. 68 and 69, were built at the Bath Iron Works, of Bath, Me., and No. 68 is now stationed off Fire Island, at the entrance to New York harbor. The same dimensions apply to both. They are strongly built, composite vessels, 122 feet 10 inches long over all, 29 feet 6 inches beam and 22 feet molded depth. The two steel masts supporting the electric lights are 64½ feet high, and each carries a gallery for day signals. The propelling machinery, to be used in steaming to the station or away from danger, is operated by simple, condensing, vertical engines, with 20-inch cylinders, 22-inch stroke and 350 H. P., at 150 revolutions. Steam is supplied, at 100 lbs. pressure, by a steel Scotch boiler, 12 feet 2 inches diameter and 11 feet long. Two vertical donkey boilers furnish steam for the electric lighting plant, windlass, pumps, fog signals and heating. Each vessel is fitted with steam-steering gear, bells, steam winch, anchors, chain cables, etc.

The electric plant, which is in duplicate, was made by the General Electric Co., of Schenectady, N. Y. Each plant contains two marine generating sets, with dynamo and engine. The four-pole dynamos are 8 kilowatt, 350-revolution machines, directly coupled to 4½ x 4-inch double cylinder engines. These dynamos furnish a 100-volt current to eight 100-c. p. lamps, four at each masthead, and forty 16-c. p. lamps about the vessel. The masthead lights are each enclosed in a lens lantern, of which three are used and one held in reserve. Appliances are employed for breaking the circuit at regular intervals, so that a fixed white light shows for 12 seconds, followed by an eclipse of 3 seconds. The focal plane is 57 feet above the sea and the lights will be visible for 15 nautical miles in clear weather.—*Scientific American.*

GUN OF NEW TYPE SUCCESSFULLY TESTED.

A very interesting and highly satisfactory preliminary test of a new type of steel gun was conducted during the latter part of January at the Sandy Hook Proving Ground. The gun, which is of the 5-inch rapid-fire class, is so simple in construction that no drawings are needed to describe it to our readers. It is made of a single forging of steel, which, having followed the course of manufacture usual for large gun forgings, was, at a proper stage of manufacture, cooled from the interior from such temperature as to produce properly disposed initial strains of such intensity as would place the wall of the gun in the best condition to resist interior pressure.

The manufacture of the gun is due to the suggestions of Capt. F. E. Hobbs, Ordnance Department, United States Army, who pointed out several years ago to the chief of ordnance the advantages that could be obtained in the manufacture of guns by applying to forgings a modification of the Rodman principle of casting guns; that the process as applied to forgings could be made to produce exactly the initial strains desired; that these strains could be easily increased or diminished at little cost, and that guns so made, while quite as strong, would be much cheaper to make than those built up.

An experimental forging made under Capt. Hobbs' direction at the Bethlehem Iron Works showed such excellent results, on being cut up and carefully examined, that the chief of ordnance ordered this 5-inch gun to be manufactured.

The thickness of metal which the gun should have and the proper initial strains to be applied to give great strength were computed by Capt. R. Birnie, ordnance department, from his formulæ on the strength of guns. Capt. Birnie was an early convert to the methods of manufacture proposed, and has materially assisted Capt. Hobbs in perfecting the details of plans.

The gun is fitted with Gordon's breech mechanism, uses fixed ammunition, smokeless powder, a projectile weighing 55 pounds, can be fired from six to ten times per minute, depending upon the conditions of loading and aiming, and has a range of more than six miles. In the Sandy Hook tests a velocity of over 2700 feet per second at the muzzle was shown, and in the special high pressure test to which the gun was subjected, pressures were registered of nearly 50,000 pounds per square inch.

The method of manufacture can be applied to forgings of any size that

can be turned out by the steel-producing plants of the country; consequently the calibre of gun which can be made of a single forging may be, to-day, set at 8-inch, but, by using this method, the number of parts in guns of larger calibre could be much reduced, while the guns themselves would be stronger.

It is probable, also, that the commercial engineering interests of the country will be found ere long following the lead of the ordnance department in this latest improvement in the treatment of steel forgings, as they did many years ago, in demanding for their structures oil-tempered and annealed steel forgings, after that department of the army had shown conclusively, by careful experimental investigation and by actual test, the safety and superiority of such metal.—*Scientific American.*

SCHNEIDER-CANET QUICK-FIRING AMMUNITION.

The chief characteristics and new features of the Schneider-Canet ammunition are as follows:

(1) The complete separation of projectiles from cartridges up to the moment of firing.

(2) The employment of one special shell for several purposes. The system is applicable to all calibres alike, but offers the greatest advantages for field service. The temporary attachment of the projectile to the cartridge is carried out by means of a sort of bayonet joint fitting, by which studs in the interior of the metal cartridge mouth enter grooves of the bayonet joint form on the projectile base, which is readily done by a push and twist when desired.

This shell combines a maximum amount of mitraille with great structural strength. The central space is filled with a compact composition generating a great quantity of smoke and of high incendiary power. This gives the advantages of a burst which is strikingly visible and of the power to set fire to combustible material.

In short, it is claimed for the system thus briefly described that it combines the following advantages belonging respectively to ammunition with charge and projectiles fixed together and kept separate from each other. Under the head of the former are chiefly the rapid loading in a single operation without the use of a rammer, regular and accurate placing of the projectile in its true position in the bore. Under the head of advantages of separation are the better packing and handling of charge and projectile separately, the prevention of accidents to the rim of the brass case in transport, the power of testing, examining, and re-charging the cartridges at any time, and the reduction of the length of the metal at the neck of the case. In addition to the above the following advantages are obtained: The employment in the field of a single projectile which involves only a single scale of elevation and fuse; the regulation of fire and visibility of burst at all ranges; a great effect on troops in consequence of the great delivery of mitraille; an effective attack on existing defensive works and on the defenders behind them; the ignition of buildings and wooden structures; and the doing away with cast-iron shells, case shot and incendiary projectiles as distinct classes by the substitution of one projectile.—*Engineer.*

PRESERVATION OF BOILERS.

A method of preserving boilers not in use has been prescribed for the French navy. According to this the boilers are completely filled with fresh water, and in the case of large boilers with large tubes there is added to the water a certain amount of milk of lime or a solution of soda; in the case of tubular boilers with small tubes milk of lime or soda is added, the solution, however, not being so strong as for the larger tubes, in order to avoid any danger of contracting the effective area by deposit from the solution. The strength of the solution is to be just sufficient to neutralize any acidity of the water. Care is enjoined to be taken to preserve the outside of the steel or iron tubes in those boilers which are not to be used for long periods; such are for this purpose painted with red lead or coal tar as far as it is possible to reach, while for those portions which are inaccessible a protective coating is obtained by burning under the tubes a certain amount of tar or coal tar, the smoke of these forming a coating of soot, which prevents the air from reaching the surface of the tubes. Besides this treatment the boiler casing is closed and kept air-tight, after some quicklime has been placed inside. Periodical inspections of these boilers are made to ensure the complete filling of the tubes.—*Engineer.*

TESTS OF CORN PITH CELLULOSE.

Some experiments were carried out by the Gunnery Establishment at Portsmouth on January 18th with the view of testing the powers of corn pith cellulose in stopping leaks. This material has been introduced from America and is said to possess great advantages over cork when used for packing cofferdams at the water-line in the unarmored ends of ships of war. A cofferdam had been erected in the Nettle 3 feet thick and it was tightly packed with cellulose blocks. In front and at the rear of the cofferdam were steel plates, so as to represent the side of a ship. From a 5-inch gun a 50-pound shell was fired into the structure. The shell burst inside the cofferdam, blowing out a part of the rear plate and some of the cellulose. After this the water test was applied, water being made to flow into the shot-hole in front. In about 20 minutes it had soaked through the packing and was pouring out through the rent in the back plate. So far as shell fire was concerned, therefore, the result of the trial was not altogether favorable to the new invention.—*Engineer.*

TRIAL OF VICKERS PLATE.

An armor-plate experiment was conducted at Shoeburyness on December 13, 1897, the object of which was to ascertain the effect of firing a 9.2 steel common shell against a 6-inch plate inclined to an angle of 30 degrees to the normal. The plate was supplied by Messrs. Vickers and the dimensions were 6 inches by 8 feet by 6 feet. It was made of specially treated nickel steel, and was held in wood struts front and rear, which were secured at the top by screwed bolts and held at the bottom between iron slabs running parallel to the plate and buried 6 feet into the ground.

The backing was of 4-inch teak, behind which were ½-inch steel plates, the whole being secured to the armor plate by eight bolts. The target, as thus described, exactly represented the side of a battle-ship of the Canopus and Vengeance class. The gun used was a 9.2-inch breech-loader, giving a striking velocity of 1892 foot-seconds and a striking energy of 9460 foot-tons. The projectile was of the usual service design, weighing 381¼ pounds, and was filled and fused in the ordinary manner. The shot struck 2 feet 9 inches from the bottom and 3 feet 5 inches from the right edge of the plate, and broke up against the hardened face without materially damaging the plate in any way, beyond causing a slight indentation at the point of impact and slightly scaling it around the centre. The supports, etc., were shifted rearwards, but the plate was for all practical purposes uninjured.—*Engineer.*

TRIAL OF VICKERS GUN.

Further trials were made December 13, 1897, at Shoeburyness with the Vickers 6-inch quick-firing gun, which gave such excellent results last October. The new trials were made to test the present accuracy of the weapon after having fired 200 rounds, and also to further test its rapidity. The charge consisted of a 100-pound shell, with cordite and service primers. In the first 10 rounds, in which the gun was tested for accuracy, two of the shells actually passed through the same hole in the target. In the rapidity tests 36 rounds were fired in 4 minutes 47 seconds, in which time was included that necessary for taking the temperature of the vent head. The greatest speed attained was one round in 6½ seconds, whilst eight rounds were fired in 7 seconds each. The gun has given a muzzle velocity of 2784 feet with a pressure of 15.9 tons. A peculiarity about this quick-firing gun consists in the fact that no metal cartridge case is used.—*Engineer.*

SHIPS OF WAR.

General.

The war-ships, exclusive of torpedo-boats, launched during the year 1897 for the various navies, with their tonnage, I. H. P., and estimated speed, were as follows:

Great Britain.—First-class battle-ship: Canopus, 12,950 tons, 13,500 I. H. P., and 18 knots speed. First-class cruisers: Andromeda, Europa, Niobe, all of 11,000 tons, 16,500 I. H. P., and 20.5 knots speed. Second-class cruiser: Vindictive, 5800 tons, 10,000 I. H. P., and 19.5 knots speed. Third-class cruisers: Pactolus, Perseus, Pomone, Pegasus, Pyramus, all of 2200 tons, 7000 I. H. P., and 20 knots speed. River gunboats: Heron, Jackdaw, Nightingale, Sandpiper, 82 tons and 9 knots speed. Torpedo-boat destroyers: Ariel, Cheerful, Fairy, Fawn, Flirt, Flying Fish, Gypsy, Leopard, Osprey, Panther, Seal, Sylvia, Wolf, all of 300 tons, 6000 I. H. P., and 30 knots speed.

Argentine Republic.—Training-ship: Presidente Sarmiento, 2352 tons, 2000 I. H. P., and 13 knots speed.

Austria-Hungary.—Torpedo cruiser: Zenta, 2300 tons, 5000 I. H. P., and 20 knots speed.

Brazil.—Double-turret monitor: Vinte e Quatro de Maio, 5000 tons,

6000 I. H. P., and 15 knots speed (originally launched in 1885), has now been rebuilt.

CHILI.—First-class armored cruiser: General O'Higgins, 8500 tons, 16,000 I. H. P., and 21 knots speed.

CHINA.—First-class cruiser: Hai-Tien, 4300 tons, 17,000 I. H. P., and 24 knots speed. Second-class cruiser: Hai-Yong, 2950 tons, 8000 I. H. P., and 19 knots speed. Torpedo cruiser: Feiting, 1000 tons, 2400 I. H. P., and 24 knots speed.

FRANCE.—First-class cruiser: Guichen, 8277 tons, 23,670 I. H. P., and 23 knots speed. Third-class cruisers: Lavoisier, 2317 tons, 6400 I. H. P., and 20 knots speed; D'Estrees, 2452 tons, 8500 I. H. P., and 20 knots speed. Torpedo-aviso: Dunois, 896 tons, 6800 I. H. P., and 23 knots speed. Despatch-boat: Kerseint, 1243 tons, 2200 I. H. P., and 15 knots speed.

GERMANY.—First-class battle-ship: Kaiser Wilhelm II., 11,180 tons, 13,000 I. H. P., and 18 knots speed. First-class armored cruiser: Fürst Bismarck, 10,650 tons, 19,000 I. H. P., and 19 knots speed. Second-class cruisers: Freya, Hertha, Victoria Louise, all of 5700 tons, 10,000 I. H. P., and 18 knots speed.

ITALY.—First-class battle-ships: Ammiraglio di Saint Bon, Emanuele Filiberto, both of 9800 tons, 13,500 I. H. P., and 18 knots speed. First-class armored cruisers: Giuseppe Garibaldi, Varese, both of 6840 tons and 13,000 I. H. P., and 20 knots speed.

JAPAN.—Second-class cruiser: Takasago, 4150 tons, 15,500 I. H. P., and 22 knots speed.

THE NETHERLANDS.—Second-class cruiser: Zeeland, 3900 tons, 9250 I. H. P., and 20 knots speed.

NORWAY.—Third-class battle-ships: Harald Haarfagre, Tordenskjold, both of 3400 tons, 4800 I. H. P., and 16 knots speed.

RUSSIA.—No large ships, but seven torpedo-boat destroyers of the Sokol type, viz. 240 tons, 4500 I. H. P., and 29.5 knots speed.

SPAIN.—First-class armored cruiser: Cardinal Cisneros, 7000 tons, 15,000 I. H. P., and 20 knots speed. Third-class cruisers: Marques de la Victoria, Don Alvaro de Bazan, both of 823 tons, 4600 I. H. P., and 19 knots speed. Torpedo-boat destroyers: Audaz, Osado, Pluton, all of 400 tons, 6000 I. H. P., and 30 knots speed.

UNITED STATES.—First-class gunboats: Wheeling, Marietta, Princeton, all of 1000 tons, 800 I. H. P., and 13 knots speed.—*Journal of the Royal United Service Institution.*

[AUSTRIA.]

BUDA-PEST.

The Imperial Austro-Hungarian coast-defense ironclad Buda-Pest has recently completed a successful series of official steam trials at Pola. The Austrian Navy now possesses three coast-defense ironclads, namely, Wien, Monarch, and Buda-Pest. These vessels have been constructed from the designs of Herr Obingenieur Siegfried Popper, of the Austrian Navy, and are in every respect similar excepting the boiler installation. The Wien and Monarch are fitted with cylindrical boilers and the Buda-Pest with Belleville water-tube boilers. All three vessels were tried at Pola, each loaded to the same displacement and run over the same course, the trials being under the observation of the same Austrian naval officers forming the commission representing the government. The principal dimensions of the vessels are as follows: Length, 305 feet; breadth, 55

feet 9 inches; draught, 21 feet; displacement, 5550 tons; armor belt, 10.6 inches; barbette, 10.6 inches; protective deck, 2.36 inches. The armament consists of four Krupp 9.4-inch; six quick-firing 5.9-inch; 15 quick-firing 3-pounder; two machine guns, two torpedo tubes. The machinery consists of two sets of triple-expansion engines having cylinders: high pressure, 33½-inch; intermediate pressure, 51-inch; low pressure, 78¾-inch; stroke, 35½-inch; steam being supplied, in the case of the Wien and Monarch, by cylindrical return-tube boilers, having a total heating surface of 15,750 square feet, and grate area of 568 square feet, and in the Buda-Pest by Belleville water-tube boilers, having a total heating surface of 22,500 square feet, and grate area of 720 square feet. The propellers of the three vessels were of the same diameter and surface; pitch being 15 feet 6 inches in the case of the Wien and Buda-Pest, altered to 15 feet 3 inches in the case of the Monarch. Appended we give comparative results of the natural and forced-draught trials of the three vessels.

Natural-draught trial of six hours' duration.

	Wien.	Monarch.	Buda-Pest.
Mean number of revolutions	121.7	119.8	124
Mean indicated horse-power	6376	6110	6608
Mean steam pressure in boilers, pounds per square inch	138	130	230
Ditto, at engines	132	121	129
Vacuum	26.4	27	27.9
Mean air pressure	.63	.6	nil
Mean speed of ship	16.7	16.2	17.1

Full-power forced draught trial, four hours' duration, during two hours of which the vessel steamed over measured course, 17 knots, accurate observations being taken as to power, speed, etc.

	Wien.	Monarch.	Buda-Pest.
Mean revolutions	131.2	135.76	135.6
Mean indicated horse-power	8480	8900	9185
Mean steam pressure in boilers, pounds per square inch	149	145	199
Ditto, at engines	142	131	149
Vacuum	25.5	25.5	26.4
Mean speed in knots	17.49	17.35	17.87
Number of ventilating fans (stokehold)	8	8	4
Mean air pressure	1¾	1¾	$\frac{2}{10}$

The stokers were drawn entirely from the Austrian Navy. The coal used was Nixon's Navigation, and being measured in the case of the natural-draught trial of the Buda-Pest, the consumption was ascertained to be about 1.8 lb. per indicated horse-power. Thermometers were placed in various parts of the engine and boiler-rooms, between decks, and in the cabins. The temperature registered during the trial being carefully noted, it was found that the temperature in all parts of the ship was much lower in the case of the Buda-Pest than her sister vessels. The representatives of the Austrian government considered the results of the trials as highly satisfactory, both engines and boilers working smoothly throughout. It will be observed that the adoption of Belleville

water-tube boilers enabled such a large increase of heating and grate surface when fitted in the same space as the cylindrical boilers, that a higher power and speed could be realized under practically natural-draught conditions than could be obtained with the cylindrical boiler under forced draught with considerable air pressure. It has been decided to fit Belleville boilers in the new armored vessels which are building for the Imperial Austrian Navy.—*Engineering.*

[China.]

Hai-Tschen.

The Hai-Tschen, another of the three cruisers building at the Vulcan Works at Stettin, was launched December 11. She is of the same type as the Hai-Yung, of 2950 tons, 8000 H. P., and 19½ knots, the principal characteristics of which were given in No. 84, page 756.

Hai-Chi.

On January 24 was launched from the Armstrong Works the Hai-Chi, protected cruiser of 4300 tons, 17,000 H. P., calculated to make a speed of 24 knots, a sister ship to the Hai-Tin launched November 25.

The principal dimensions of the vessel are as follow: Length, 396 feet; breadth, 46 feet 8 inches; mean draught, 16 feet 9 inches; displacement, in tons, 4300. Her armament will consist of two 8-inch Elswick quick-firing guns, ten 4.7-inch Elswick quick-firing guns, twelve 3-pounder Elswick quick-firing guns, four 37-millimetre Maxims, six rifle calibre Maxims, and five 18-inch torpedo tubes. The vessel will have a strong steel protective deck, extending right forward and aft, so as to protect completely the machinery, magazines and steering gear, the deck varying in thickness from 1½ inches on the flat to 5 inches on the slopes. The conning tower will be built of armor 6 inches thick, so as to afford efficient protection to the steering wheels, etc., when the vessel is going into action. The total coal capacity is about 1000 tons, giving a steaming radius of 12,000 miles. The speed guaranteed on trial is 24 knots during a trial of four hours' duration.

[Denmark.]

Naval Budget.

The estimates for naval appropriations, 1898 to 1899, amount to 6,936,922 kronen, or about $1,845,000. Of this amount about $300,000 to be used in the construction of a battle-ship of 5000 tons, the Herluf Trolle. The remainder to be expended in repairs of the Iver Hvitfeldt, Geiser, Heimdal and Lindormen.

[England.]

Argonaut.

The Argonaut was successfully launched, January 24th, from the yard of the Fairfield Shipbuilding Company. She is a protected cruiser of the Diadem type, eight of which are already built or under construction, although the four most recently designed—consisting of the Argonaut; the Spartiate, which has been laid down at Pembroke; the Amphitrite, at

Barrow; and the Ariadne, at Clydebank—differ somewhat from the first quartette in indicated horse-power and in the nature of the armament mounted.

The dimensions of the vessel are as follows: Length over all, from ram end to taffrail, 462 feet 6 inches; length between perpendiculars, 435 feet; beam, 69 feet; displacement, at normal draught, with 1000 tons of coal on board, 11,000 tons. The hull is generally of Siemens-Martin steel, and the construction of the ordinary character, with frames 4 feet apart along the space occupied by the double bottom, and 3 feet apart forward and aft of this. There is a double bottom extending the full length of the machinery and boiler-room spaces, and, fore and aft of these limits, the flats of the steel water-tight magazine and of the platform decks, into which the longitudinals are worked right up to the ends of the ship, practically continue the double bottom from stem to stern. The coal capacity, at normal draught, is 1000 tons; but nearly 2000 tons can be carried, should the necessity arise for doing so, by employing the middle-deck bunkers. The hull is subdivided into a very large number of water-tight compartments by longitudinal and transverse water-tight bulkheads. Openings have been cut in these bulkheads only where it is absolutely necessary; and in such cases water-tight doors of approved pattern are fitted, all arranged to work both at the doors and by gearing leading to deck plates on the main deck. Where it is necessary for bulkheads to be cut through for ventilating trunks, or such like passages, automatic doors, closed by a self-acting counterweight, are fixed, so that if a compartment associated with the opening is flooded a small tank fills with water, raises the ballcock, and the weight, being released, falls, closing the automatic door. The stem, stern-post, and shaft brackets are of phosphor bronze, as is usual in sheathed vessels. The stem is of the ordinary ram form, and is strongly supported by the framework of the vessel by means of breast hooks and other devices, as well as by the forward parts of the armored and platform decks being built into it. The hull, below and up to about 6 feet above the load water-line, is sheathed with teak planking and coppered. Bilge keels are also fitted for a distance of 210 feet amidships; they are 3 feet in depth and splayed off at the ends, *not* disappearing at the midship section, as in the United States ships of the Wisconsin type. The protective deck, of a curved form in section, ranges in thickness from 2½ inches on the flat to 4 inches on the slopes, and covers the whole of the machinery, boilers and magazines. The conning tower forward is of Harveyized steel, fitted with the customary gear for controlling and directing the ship in action. The connections from the steering standards, etc., in the conning tower are protected by an armored trunk of thick steel leading down to the protective deck. There are navigating bridges fore and aft which secure a view over all operations on deck. The height of the forward bridge may be imagined when we say that the upper part of the stem is about 32 feet above the water-line, there being between 7 feet and 8 feet more freeboard in this direction than that possessed by the vessels of the Majestic type.

The armament of the Argonaut will be of the most recent character. Four 8-inch quick-firing guns in shields will replace the same number of 6-inch quick-firers as mounted on the Diadem. Two of these will be on the forecastle and two on the upper deck aft. Four 6-inch quick-firers will be mounted in armored casemates of Harveyized steel on the main and upper decks, capable of being trained axially forward, and four more

mounted in a similar manner capable of being trained axially aft; on either broadside are four other 6-inch quick-firers on the main deck. Twelve 12-pounder quick-firers are mounted on the main and upper decks, and two more on the superstructure forward. There are also light quick-firing and machine guns, and two torpedo tubes below water forward. The magazine and shell rooms for storing ammunition are of large capacity and are conveniently situated for working the quick-firing guns, special gear being supplied for hoisting and delivering the ammunition. The importance of this last feature will be recognized when we say that the 6-inch guns have a unit of 200 rounds each, the 12-pounders of 300 rounds, and the 8-inch guns of 150 rounds maintained in the magazines. The axial fire of the Argonaut will be exceptionally heavy, both forward and aft. Forward there will be two 8-inch, four 6-inch, and two 12-pounders capable of being trained in a line with the keel. These can discharge in one minute,

Two 8-in.	quick-firers	4	rounds	1000 lb.	} 3360 lb.
Four 6-in.	"	20	"	2000 "	
Two 12-pounder	"	30	"	360 "	

representing a hitting energy of 122,418 foot-tons.

The propelling machinery of the Argonaut will consist of two sets of triple-expansion engines, each with four inverted cylinders. Each propeller has a boss of gun-metal fitted with three adjustable blades of manganese bronze, constructed to work inwards. Steam will be supplied by thirty water-tube boilers and economizers of the latest Belleville type. The boilers are arranged in four groups, each group fitted in a watertight compartment. The boilers are designed to work at 300 pounds pressure, reducing valves being fitted to bring it down to 250 pounds at the engines. The boilers, in working condition, weigh 720 tons. In the later ships the boiler is divided into two parts; in addition to the "generator" an "economizer" is placed in the path of the escaping hot gases, and much of the heat otherwise lost is utilized in raising the temperature of the feed-water, as it passes through the economizer tubes to the generator below. There is a space between the lower series of tubes forming the generator and the upper series forming the economizer; and a supply of air is forced into this space, to ensure the combustion of the gases. The passing of the feed-water through the economizer tubes, it was found by land trials, raised the temperature from 68 degrees Fah. to 226 degrees under ordinary conditions, and to 330 degrees when the boiler was pressed. At the same time the temperature of the gases was reduced by more than half in its passage through the economizer tubes, from 860 degrees to 394 under ordinary conditions, and from 1560 degrees to 750 when the boiler was pressed. A speed of 20¾ knots per hour is expected, with 18,000 indicated horse-power.

The Argonaut will be rigged with two light masts, each fitted with a platform, or light top, for operating electric search-lights. She has not, however, any arrangement designed for fighting tops to mount quick-firing guns.—*Engineering.*

WOLF.

The torpedo-boat destroyer Wolf, built by Messrs. Laird Brothers, Birkenhead, went out on December 30, 1897, on the Clyde for her official full-power coal-consumption trial with satisfactory results, the mean speed obtained on six runs over the measured mile being 30.3 knots with 370

revolutions, and the speed for three hours' run 30.11 knots. On January 6 she went out for her official full-power coal-consumption trial with satisfactory results, the mean speed obtained on six runs over the measured mile being 30.3 knots, with 370 revolutions, and the speed for three hours' run 30.11 knots.

Flying Fish.

The Flying Fish, torpedo-boat destroyer, built and engined by the Palmer Shipbuilding Company, had her initial three hours' coal-consumption trial on the 25th February. The mean of six runs over the measured mile in Stokes Bay gave her a speed of 30.361 knots, with 390.7 revolutions a minute, while with 393 revolutions for the three hours the speed by patent log was 30.484 knots. The indicated horse-power on the mile was 6431, and for the three hours 6457, showing remarkable uniformity in both phases of the trial. There was an abundance of steam throughout the run.

Violet.

The Violet, torpedo-boat destroyer, had a 12 hours' economical coal-consumption trial at Portsmouth on February 23. She was required to steam at 13 knots with a coal consumption not exceeding 1 ton per 30 miles. The mean speed of the 12 hours was 13.008 knots, and the consumption 1.99 lb. per unit of power per hour. The average worked out at 36½ miles per ton of coal, and, as the vessel carries 84 tons of fuel, this gives her a radius at economical speed of 3066 miles.

Gipsy.

The Fairfield Shipbuilding and Engineering Company, Limited, have completed the official trials of H. M. S. Gipsy, the first of the 30-knot torpedo-boat destroyers built by them for the British Admiralty, with most satisfactory results. The speed on six runs over the measured mile at Skelmorlie was as follows: 29.851 knots, 29.607 knots, 30.456 knots, 30.151 knots, 30.456 knots, and 30.354 knots; giving a mean of 30.176 knots. On a subsequent trial of three hours' continuous steaming the mean speed was 30.207 knots.

Bullfinch.

On February 10th H. M. S. Bullfinch, 30-knot torpedo-boat destroyer, was launched at Hull from the yard of Earle's Shipbuilding and Engineering Company, Limited, and may shortly be expected to be ready for her official trials, as her machinery is nearing completion, and her boilers were on board at the time of launching.

Seal.

The Seal, torpedo-boat destroyer, built by Messrs. Laird Brothers, Birkenhead, went out on the Clyde on January 3rd on her official full-power coal-consumption trial with the following satisfactory results: Speed on mile 30.04 knots with 370.5 revolutions, and speed on three hours' run 30.02 knots.

Locust.

H. M. S. Locust, torpedo-boat destroyer, built by Messrs. Laird Brothers, Birkenhead, went out on the 21st February for her official full-power coal-consumption trial at 30 knots, with very satisfactory results. The speed realized on six runs on the measured mile at Skelmorlie was 30.26 knots. And for three hours' continuous steaming, 30.15 knots. Her sister ship, the Seal, completed her series of trials on the 24th Feb., in the presence of the Admiralty representatives. Her official full-speed trial was commenced shortly after 10 a. m., and a speed of 30.79 knots was obtained as a mean of the six runs on the measured mile. The mean speed for the first four miles was 31.03 knots, equivalent to 36¼ miles per hour. The speed for the three hours' continuous steaming was 30.15 knots. After the completion of this trial the usual steering trials at full speed ahead and astern were carried out satisfactorily and successfully, and the stopping, starting and reversing of the engines demonstrated their efficiency.

[France.]

Building Program.

The following is the building program as at present settled for 1898: At Brest, a first-class battle-ship A9; at Cherbourg, a first-class armored cruiser C4; at Lorient, a first-class armored cruiser C7. To be built by contract: One first-class armored cruiser C8, of 9517 tons, to be a sister ship to the Montcalm; two first-class armored cruisers, ex-D4 and ex-D5, of 7700 tons, to be called the Desaix and Kleber; five torpilleurs-de-haute-mer and six first-class torpedo-boats.

The total number of new vessels completing, building and to be laid down is 84, divided as follows: 8 first-class battle-ships, 10 first-class armored cruisers, 4 first-class station cruisers, 3 second-class cruisers, 3 third-class cruisers, 1 first-class aviso, 10 torpedo-boat destroyers, 6 sea-going torpedo-boats, 36 first-class torpedo-boats, 1 submarine torpedo-boat, 1 gunboat, 1 gunboat launch. Of these numbers, 61 are actually under construction in government and private yards, leaving 20 to be commenced before the end of 1898.

The new battle-ship to be built at Brest is to have a displacement of 12,000 tons, but her plans are not yet completed. It is intended to lay down the Kleber and Desaix before the end of this year, if possible, but the contracts have not yet been signed. Their dimensions will be as follows: Displacement, 7700 tons; length, 422 feet 6 inches; beam, 58 feet; engines and boilers of the same system as Montcalm class; H. P., 17,100; speed, 21 knots; coal stowage, 5200 tons; radius of action at 10 knots, 8800 miles; radius of action at full speed, 1650 miles; armament, ten 16.4-centimetre (6.3-inch), ten 3-pounder and six 1-pounder Q. F. guns, with two above-water torpedo discharges. The station cruiser to be built at Rochefort will have a displacement of about 5000 tons, but the plans are not yet completed.

The destroyer Yatagan will be similar to the Pique, Epee and Framee, namely: displacement, 303 tons; H. P., 4800; speed, 26 knots; armament, one 65-millimetre and six 47-millimetre Q. F. guns; two above-water torpedo tubes. The designs for the five sea-going torpedo-boats are not yet completed, but they will have a displacement of about 150 tons. The six first-class torpedo-boats will have a displacement of 84 tons and a

speed of 23 knots. Armament, two 37-millimetre guns and two torpedo tubes.

The plans of the new battle-ships and cruisers are all due to M. Bertin, head of the Section Technique des Constructions Navales, who will be held responsible. This is a new departure, as up to the present no definite responsibility for the ship designs was attached to any single official.—*Journal of the Royal United Service Institution.*

A first-class armored cruiser, to be called the Dupleix, has been laid down at Rochefort, replacing the cruiser "D3," of 5500 tons, which figured in the budget vote of 1897. The Dupleix will have a displacement of 7700 tons, vertical triple-expansion engines, multitubular boilers, three propellers, and an estimated speed of 21 knots. Her armament will consist of ten 16.4 centimetre (6.3-inch), ten pounder, and six 1-pounder Q. F. guns, and two above-water torpedo discharges. Her cost will be 15,500-000 francs, and she will practically be a sister ship to the Kleber and Desaix.—*Journal of the Royal United Service Institution.*

[Italy.]

Ships under Construction.

The naval estimates for 1898 and 1899 amount to 105,963,646 lire, but as some deductions have to be made, the real total is 94,769,124 lire, of which 24 millions and a half are devoted to the personnel and 19,500,000 lire to new constructions and completing during the current year the following ships: First-class battle-ships—Emanuele Filiberto, completing at Naples, and Ammiraglio di Saint Bon at Venice. First-class armored cruisers—Vettor Pisani, completing at Naples; Giuseppe Garibaldi, completing at the Ansaldo Works, Sestri Ponente; Varese, completing at the Orlando Yard at Leghorn. Second-class ram cruiser—Puglia, fitting out at the dockyard at Taranto. Torpedo cruisers—Agordat and Ciotat, building at Naples and Castellamare respectively.

At Castellamare a new torpedo cruiser of the Agordat type is to be laid down, besides some torpedo-boat destroyers and torpedo-boats, but with regard to the proposed new battle-ships no decision as to their type would appear to have been yet arrived at, although it is stated that four are to be laid down. By the end of the financial year, 1st July, 1899, the active fleet will consist of 320 vessels of all classes, 51 of which will be battle-ships and cruisers and 146 torpedo-boats.—*Journal of the Royal United Service Institution.*

The Duilio is refitting at Spezia, same as the Dandolo. She is to receive a new armament, new boilers and engines, to give a speed of 18 knots. If these changes come up to expectations all the older ships are to be similarly refitted and rebuilt.

[Japan.]

Akashi.

The latest papers from the Far East bring an account of the launch at the Yokoska shipbuilding yard of the cruiser Akashi, a sister vessel, we believe, to the Suma, which was launched from the same yard about

two years ago. The Yokoska shipbuilding yard, which is situated a few miles below Yokohama, was under the charge of French engineers and shipbuilders for a good many years, but now it is entirely managed by Japanese, who, after having studied in their own country, extended their practical knowledge in some of the largest shipbuilding yards in Europe.

The Akashi is a steel twin-screw cruiser of 295 feet in length, 41 feet 7½ inches in beam, 15 feet 8½ inches in draught, 2800 tons displacement, and 8000 horse-power. It is expected that she will attain a speed of 19½ knots. Her coal bunkers have a capacity for 600 tons, and her armament, when completed, will consist of six 12-centimetre quick-firing guns, two 15-centimetre quick-firers, four machine guns, and two torpedo-tubes; the six 12-centimetre in sponsons, three of which are constructed on either side of the ship, the two 15-centimetre guns being mounted behind shields, fore and aft. The difficulty of shipbuilding in Japan, especially for the navy, will be understood when it is remembered that practically all the steel used in construction requires to be imported, and therefore that much of the special work which engineers and shipbuilders in this country get done at outside establishments, requires to be done in the yard at Yokoska.—*Engineering.*

Kasagi and Chitose.

This protected cruiser was successfully launched at Cramp's shipyard, January 20th. She is the first foreign warship launched in America for twenty years. Two days later the Chitose, building at the Union Iron Works, San Francisco, was launched. The Kasagi is modeled on the lines of the fast and powerfully armed protected cruisers which have been built by Armstrong, of England, for the Japanese and other foreign navies. She is 396 feet long, with 49 feet of beam and a draught of 17 feet 9 inches, her displacement at this draught being 4900 tons. The motive power is supplied by two vertical, inverted, triple-expansion, four-cylinder engines, driving twin screws, and estimated to develop, under forced draught, a mean speed of 22½ knots per hour. The engines are of 17,000 horse-power, and the boiler-rooms contain twelve single-ended boilers, 14 feet 2 inches in diameter and 9 feet 9 inches in length. She will carry enough coal to cruise for 4000 miles at 10 knots an hour. In the specifications she is classed as a protected cruiser of the second class, and like all vessels of her type has no defensive armor, relying on her coal bunkers, which run 108 feet fore and aft of her amidship section, to protect her engines, which are entirely below the water-line. Above these is a protective deck, having a maximum thickness of 4½ inches on the slopes and 1¾ inches on the flat, giving ample protection to the vital parts of the ship.

The batteries of the Kasagi are heavier than those on either the United States cruisers Minneapolis or Columbia, and it is alleged that the new cruiser, because of her superior protection, will have greater defensive and offensive power. There are no turrets on the Kasagi, but she will be quite well protected by guns. There are two 8-inch rifles at the sides, and her armament besides will consist of ten 4.7-inch quick-firing rifles mounted in broadside, a secondary battery of twelve 12-pounder quick-firing rifles, and six 2½-inch Hotchkiss guns. The 8-inch rapid-fire guns have a speed of fire three times that of the old slow-firing type, so that these two guns alone would equal the six 8-inch guns carried on our own New York, a ship of 8000 tons displacement. As the energy of each

shell from the New York's 8-inch guns is 7498 foot-tons and that of the shells from the Kasagi's 8-inch guns is 10,662 foot-tons, we see what an enormous advantage is gained by the adoption of the rapid-fire system. In the present instance it brings the offensive power of a 4900-ton ship up to and beyond that of an 8000-ton ship. This comparison is an important commentary upon the urgent plea of Assistant Secretary of the Navy Roosevelt for the arming of our cruisers with guns of the rapid-fire type.

New Japanese War Vessels.

In addition to the new second-class cruisers, Kasagi and Chitose, building in this country, Japan is having built at various places nearly forty battle-ships, armored cruisers, protected cruisers, torpedo-boats and torpedo-boat destroyers. These include three 14,800-ton battle-ships, which are well advanced at Armstrong's, Thompson's and the Thames Iron Works, respectively, in England; one battle-ship of about 10,000 tons, also under way at Armstrong's; four first-class armored cruisers of 9600 tons displacement and twenty knots speed—two of these at Armstrong's, one at the Vulcan Works, Stettin, Germany, and one at Forges et Chantiers, France; one protected cruiser of 4300 tons and about twenty-three knots speed at Armstrong's; four thirty-knot torpedo-boat destroyers at Yarrow's, England, and four more of a similar type at Thompson's; eight ninety-ton torpedo-boats at the Schichau Works, Elbing, Germany, and four more of a similar type at the Normand Works, France; three 3000-ton protected cruisers of twenty knots, three torpedo gunboats and a dispatch vessel at the Imperial dockyards, Yokosuka, Japan, and an armored cruiser of 9600 tons and twenty knots, to be also built at Yokosuka. All of these vessels are expected to be completed by 1903.

[Portugal.]

Adamastor.

The latest addition to the Royal Portuguese Navy is the twin-screw cruiser Adamastor, which performed her speed trials and was accepted in July, 1897. The ship was built and engined by Orlando Brothers, of Leghorn; her general dimensions are as follows, viz.: Length, between perpendiculars, 242 feet 2 inches (73.810 m.); length, over all, 261 feet (79.622 m.); breadth, 35 feet 2 inches (10.730 m.); depth, moulded, 21 feet 4½ inches (6.500 m.); normal displacement, 1765 metric tons; displacement, with 419 tons of coal on board, 1962 tons. The hull is of steel and is partially double bottomed. The whole is divided into twenty-three main water-tight compartments, and the lower deck is of steel with water-tight doors.

The armament consists of two 15-cm. Krupp guns, placed one on the topgallant forecastle and one on the raised quarterdeck; four quick-firing 10.5-cm. and four quick-firing 6.5-cm. Krupp guns on the main deck; two 37 mm. Hotchkiss guns on the bridge; two 6.5 mm. Nordenfeldt machine guns on the fighting tops. Besides, there are three torpedo tubes, one forward and two on the broadside on the main deck.

The conning tower is of steel, 2½ inches thick. There are six boats, one of which is a steam launch. On the quarterdeck there is a very elegant state-room; the chief commander's bed, drawing and bath rooms; the second commander's bed and bath rooms; the pantry, the chart room,

&c. &c. The officers' accommodation is aft, but under the main deck; the officers' mess-room, which is near the midshipmen's mess-room and cabins, extends the full breadth of the ship. The topgallant forecastle is occupied by petty officers' cabins and sailors.

Great care was taken in ventilating the ship with natural draught; but besides this, two electric ventilators, 4 feet in diameter, are provided for use in hot climates, and they blow the fresh air, not only into every cabin, but also into the store-rooms, steering engine-room and magazines. The vessel is propelled by two triple-expansion engines, designed to develop 4000 indicated horse-power, placed in separate water-tight compartments, the high-pressure cylinders being forward; the bed plates, the cylinder frames, which are of the inverted Y form, as well as the covers of the cylinders and valve chests, are of cast steel. The cylinders' diameters are: High-pressure, 23¼ inches (0.59 m.); intermediate, 37⅜ inches (0.95 m.); low pressure, 59½ inches (1.50 m.). The common stroke is 31½ inches (0.80 m.). The main condensers are in the wings—they are cylindrical—and built with Muntz sheets; the total combined condensing area is 4862 square feet. The propellers are of Delta metal, three-bladed, 10 feet 11½ inches in diameter (3.340 m.), the projected surface of each propeller being of 30.66 square feet (2.85 m. q.). Steam is supplied by four marine single-ended boilers, placed in separate water-tight compartments; they are 13 feet 6⅞ inches in diameter and 12 feet 3½ inches long, with three Fox's furnaces, each 3 feet 7⅛ inches mean diameter. The total heating surface is 8823 square feet (8.20 m. q.); the total grate area is 262 square feet. The working pressure is 160 lbs. per square inch. Four ventilating tubes, 39½ inches in diameter, supply air to the boilers at natural draught, and four ventilating fans, 5 feet 3 inches (1.600 m.) in diameter, are provided for the forced draught, which is on the closed ashpit system. One auxiliary boiler, having 223 square feet of heating surface, is placed on the main deck. A very complete system of pumping arrangement is fitted, and we may mention the two 500 tons per hour centrifugal pumps, the bilge and auxiliary pumps, capable of pumping overboard 100 tons of water per hour, and the two 50 tons each steam ejectors.

Three trials were to be made. The contract speed at natural draught, six hours' trial, was to be 16 knots, with 115 revolutions and 3000 indicated horse-power the main engines. The official results of this first trial, made on the 28th June, 1897, are: Mean speed, 17.19 knots; mean revolutions 119, with a maximum of 122; indicated horse-power varying from 2900 to 3100. On the following six hours' trial, at 10 knots speed, the coal consumption was not to exceed 154 lbs. (70 kilos.) per mile. The trial was made on 30th June; the power developed by the main engines, running at 67 revolutions, corresponding to 10-mile speed, was 523, and the coal consumption in the six hours was 4629 lbs. (2100 kilos.), that is, 77 lbs. per mile, or 1.45 lb. per indicated horse-power.

The coal capacity of the bunkers being of 419 tons, the radius of the Adamastor at 10 knots speed is at least 8896 miles, including the coal consumption of the galley, water-distilling apparatus, etc.

The two hours' forced-draught trial was to give a speed of 17.3 knots with 130 revolutions of the main engines and 4000 indicated horse-power. The trial was made on the 8th of July, on which occasion the photograph of the vessel at sea, reproduced as our supplement this week, was taken, with the following results: speed, mean, 18.04 knots; revolutions, 131.5; mean indicated horse-power, 4030; steam pressure in the boilers varying

from 156 lbs. to 160 lbs.; air pressure in the ashpits, ⅞ inch of water. The engines as well as the boilers worked during all the trials in the most satisfactory manner, no part of the engines getting heated, nor was there any priming.

The Adamastor's electric plant consists of two 4-pole dynamos, directly coupled to the vertical single cylinder double-acting engines, 8 inches in diameter, with 5½-inch stroke, working at 275 revolutions per minute. The current output of each dynamo is 110 ampères, at 65 volts. There are 190 lamps through the ship, and two 16-inch diameter, 50-ampère, search-lights on the mast.—*Engineer.*

Don Carlos I.

An armored cruiser, Don Carlos I., of 4100 tons displacement, is building in England for the Portuguese government. The armored deck to have a thickness of 1½ to 4 inches. Two triple-expansion engines, steam supplied by water tubular boilers, are to give a speed of 22 to 23 knots under forced draught. Coal capacity 1000 tons, giving a radius of action of 10,000 miles at 12 to 13 knots. The armament, entirely of rapid-fire guns, comprises two 7.8-inch and ten 4.7-inch guns, protected by 3-inch gun shields; twelve 47-mm. and six 37-mm. guns, besides four Maxim machine guns. There will be five torpedo tubes, three being submerged.—*Moniteur de la Flotte.*

Gunboats.

Two gunboats, Almirante Baptista de Andrade and Thomaz Andoa, of 220 tons each and 10 to 12 knots speed, are building. They are to be armed with small rapid-fire guns.

[Russia.]

Ships under Construction.

It is stated that the naval estimates for the coming year, when published, show an increase of 6,000,000 roubles on those of last year, and that the credit allotted for the construction of new warships will amount to 24,800,000 roubles, and attempts will be made to carry out the building much more speedily than heretofore. At pre'sent a large armored cruiser of the type of the Rossia is being constructed at the Baltic Works on the Neva; she will have three engines and three propellers, and the engines are to develop a total of 18,000 I. H. P. In the same yard two torpedo destroyers of the type of the Sokol are being built; their hulls will be of nickel steel, and their engines will develop about 4400 I. H. P., and they are intended to be in all respects superior to the Hornet, and in some minor points improvements on the Sokol. In Abo, at the works of Greighton and Co., two more torpedo destroyers of the same type are in process of construction. In the Admiralty Works at Ijora a battleship of 12,674 tons displacement, 434 feet long and 26 feet draught, of the type of the Oslabija, is being built, and no less than twenty-four torpedo destroyers of the Sokol type. Of these, twelve will be taken in parts to the port of Vladivostock and twelve will be left in the Baltic port. A lightship for Nekmangrund and another for Port Nikolaieff in the Black Sea have also been ordered at the same place. An armored ship of 8800 tons displacement and 341 feet long, of the type of the

Rostislav, is to be built at Nikolaieff for the Black Sea fleet. In the same works a battle-ship of 12,480 tons displacement and 357 feet long, of the type of the Three Saints (Tri Sviatitelya), will shortly be laid down. Further, engines are now being made for the unchristened cruiser of the type Rossia (18,000 I. H. P.), for the new cruiser of the type Pallada (11,610 I. H. P.), for the cruisers Diana and Aurora (11,610 I. H. P.), for the armored turret-ship Peresjet (14,500 I. H. P.), for the Oslabija (14,500 I. H. P.), and for the barbette ship of the type of the Tri Sviatitelya (10,600 I. H. P.).

The Ministry of Marine has decided to provide next year the following guns: Twenty-five 12-inch, 40 calibres in length; sixteen 10-inch, 45 calibres long; one 8-inch; forty-nine 6-inch Q. F. guns; twenty-three 120-mm. Q. F. guns; a hundred 75-mm. Q. F. guns; eight Baranovsky 2½-inch guns; 134 Hotchkiss 47-mm. guns; and ninety-six Hotchkiss 37-mm. guns. In addition, hydraulic carriages will be built for the 12-inch and 10-inch guns, turret mounts for the 6-inch pieces, and fixed carriages for the others. The Admiralty has also ordered 100 Whiteheads (new model), ninety-six 19-feet Whiteheads, and twenty 45-cm. torpedoes. 112,000 roubles are to be expended on hand torpedoes and 87,000 roubles on electric naval mines and mining material. For the vessels in commission, 11,184,371 roubles; provisions, 6,946,906 roubles; guns and torpedoes, 5,089,296 roubles; workshops and offices, 4,487,556 roubles; for improvements in the port of Vladivostock, 6,000,000 roubles.—*Journal of the Royal United Service Institution.*

The Russian Admiralty has decided to replace the "Du Temple" boilers of torpedo-boats Nos. 125 and 126 by Yarrow straight-tube boilers, owing, it is said, to the rapid deterioration of the tubes of the former boilers—due, we are told, to their curved shape, and also because the Yarrow boilers allow of a larger heating surface.

[SPAIN.]

CRISTOBAL COLON.

It will be remembered that one of the six vessels in the last Italian naval programme (which dates so far back as 1891) was named the Giuseppe Garibaldi. She was to be built and engined complete by Messrs. Ansaldo and Co., of Sestri Ponente and Sampierdarena, near Genoa, and she was to be delivered within six years. But the capacity of the Ansaldos' works is such that the construction of the engines was completed and the ship ready for launching within 22 months.

It was just at this time that the Argentine Republic, having one of those perennial differences of opinion with its sister republic of Chili, was looking about for warships to add to its fleet as an answer to the threatening armament that Chili was gradually accumulating, and overtures were made to the Italian Government for the purchase of the Giuseppe Garibaldi. It was then arranged that Messrs. Ansaldo should have power to dispose of the vessel to Argentina on the condition that the second one should be delivered to the Italian government within the time originally stipulated for the first one; and with the further proviso that in consideration of the granting of such a favor Messrs. Ansaldo were to fit the new vessel with water-tube boilers, in place of the cylindrical ones provided for the original vessel, and that all materials for the new ship should be obtained in the kingdom of Italy as far as possible.

The name Garibaldi was retained for the Argentine vessel in recognition of all that that hero did for Argentina, and the vessel was speedily completed and handed over to the Argentine authorities. The fitting the machinery on board was a remarkably smart piece of work for any country, the engines and boilers being ready for their steam trials ten weeks after the vessel was launched. The keel of the second ship was laid on September 25, 1895, and her construction so pushed forward that there was every probability that it also would be ready for sea long before the time originally stipulated. It was at this juncture that Spain, seeing the urgent necessity of adding to her fleet some modern and really serviceable vessels, decided to purchase the Garibaldi No. 2 if it were possible, and the Italian government was again approached with a request for the cession of the second vessel. This was again granted on the same terms as before, but with a distinct warning from the Italian Ministry of Marine that on no account would any extension of time for final delivery be granted, and any fines for delay would be most strictly enforced. The launch of this second vessel took place on September 16, 1896, and was made the occasion of a most remarkable outburst of enthusiasm and scene of fraternization between the Spanish and Italian peoples. A large steamer was chartered and sent to Barcelona for representatives of all the principal Spanish newspapers, and these journalists had public receptions and festivities in their honor wherever they went. The vessel left the ways in the presence of cheering thousands, and was named Cristobal Colon by Madame Benomar, the wife of the Spanish ambassador to the court of Italy.

The leading dimensions of the vessel are as follows: Length, 328 feet; beam, 59 feet 9 inches; and draught, 23 feet 3 inches, at which the displacement is 6840 tons. The armament consists of two 25-centimetre guns placed at either end of the vessel en barbette, ten 15-centimetre, six 12-centimetre, ten 57-millimetre, and ten 37-millimetre guns, all, with the exception of the two large guns, being quick-firing. There are also two machine guns and two light guns with their carriages for use on shore.

The propelling machinery consists of two sets of triple-expansion inverted engines having cylinders 42 inches, 63 inches, and 93 inches in diameter respectively, with a stroke of 3 feet 10 inches. Each cylinder is supported by four cast-steel columns with cast-iron crosshead guides bolted on their faces and standing on cast-steel main bearing frames. The high-pressure cylinders are fitted with piston valves, while the intermediate and low-pressure cylinders have double-ported slide valves, all being worked by double eccentrics and Stephenson's link motion. The piston-rods, connecting-rods and shafts are of steel, these latter being hollow throughout, and the crankshaft being made in three parts interchangeable. The condensers, two in number, are of delta metal, and are fitted with horizontal tubes through which the water passes, and have a cooling surface of 14,600 square feet. There are two single-acting air-pumps made of gun metal 33 inches in diameter and 21 inches stroke, worked by beams from the low-pressure cylinder crossheads. There are two large centrifugal pumps, each worked by a compound engine, and each is fitted with a small auxiliary single-acting air pump for the purpose of maintaining a vacuum and keeping the main condensers free of water when the main engines are stopped. An auxiliary condenser is fitted in each engine-room, having its special circulating and air pump.

Messrs. Maudslay's latest arrangement with secondary tanks for maintaining a constant head of water against the suction valves of the feed pumps was adopted, and was found to give admirable results on the trials.

The steam-producing apparatus consists of 12 water-tube boilers of the Niclausse type, which were made in Paris. The boilers are placed back to back against the central bulkhead, three in each compartment, and a funnel is provided for each group of six boilers.

The vessel was ready for trial in March, 1897, the official natural-draught trial taking place on April 29, 1897, when the results exceeded every expectation. The boilers gave such an ample supply of steam that the full contract speed of the vessel was obtained without even putting the fans in motion. At the three hours' trial, with a mean pressure of 57.04 lbs. in the high-pressure cylinders, a vacuum of 28.2 inches, the two engines developed a collective indicated horse-power of 10,671, exceeding by 2071 I. H. P. that required by contract.

As is usual on trials with ships fitted with water-tube boilers, the firing was done regularly, each furnace being charged with a certain amount of fuel at stated intervals, a clock being fitted in each stokehold to facilitate this.

The mean speed on this trial, on a long base, was 19.35 knots, and as this was in excess of the contract speed, the commission appointed by the Spanish government to receive the vessel decided that no further full-speed trial was necessary.

Besides the substitution of water-tube boilers and the application of hotwell pumps with their tanks and service of pipes, the second vessel possesses many other improvements, which were found desirable or necessary from experience with the first Garibaldi.—*Engineering.*

[UNITED STATES.]

THE LATEST BATTLE-SHIPS FOR THE UNITED STATES NAVY.

The latest report furnished to Chief Constructor Hichborn, showing the progress which is being made in the construction of the five battle-ships which are building in private yards for the United States Navy, shows that the Kearsarge and Kentucky are more than half completed, and that from 32 to 39 per cent of the work has been accomplished on the Alabama, Illinois and Wisconsin.

These five vessels, all of which will be first-class seagoing battle-ships, belong to two different types, the first of which, authorized in the year 1895, includes two twin ships, the Kearsarge and the Kentucky, which are building at Newport News; the other type, authorized in the following year, consists of the Alabama, building at the Cramps' yard, the Illinois, at Newport News, and the Wisconsin, which is being constructed at the Union Iron Works, San Francisco.

They differ considerably from each other and from the class of ships which preceded them, represented by the Indiana, Massachusetts and Oregon. They represent the advance which has taken place in battle-ship design since the year 1890, when the Indiana class was authorized, and in the Alabama we have embodied those features of high freeboard, widely separated main battery and broadside secondary battery of rapid-fire guns which are likely to remain permanent in the navies of the world.

The leading features of the two ships are as follows:

	Kentucky.	Alabama.
Water-line length	368 ft.	368 ft.
Beam	72 " 2½ in.	72 " 2½ in.
Draught	23 " 6 "	23 " 6 "
Freeboard forward	14 " 3 "	20 "
" aft	13 " 3 "	13 " 3 "
Displacement	11,525 tons	11,520 tons
Speed	16 knots	16 knots
Coal supply	410 tons	800 tons
Horse power	10,000	10,000
Armor, nickel steel.		
Water-line belt	16½ in.	16½ in.
Side armor above belt	6 "	5½ "
Turret armor	17 and 15 "	17 and 15 "
Barbette armor	15 "	15 " 10 "
Conning tower	10 "	10 "
Protective deck	2¾ "	2½ to 4 "
Armament.		
Main battery	4 13-in. guns	4 13-in. guns.
Submain battery	4 8-in. guns	
Secondary battery,	14 5-in. R. F. guns	14 6-in. R. F. guns.
	20 6-pdr. R. F. guns	17 6-pdr. R. F. guns.
		6 1-pdr. R. F. guns.

If it is compared with the Indiana it will be evident that the greatest change in the Kentucky is in the novel method adopted for carrying the 8-inch guns. In the Indiana there were eight of these disposed in four turrets, at the four corners of the central armored battery. By this arrangement it was hoped to be able to train four guns on either beam or directly ahead. In the gunnery trials, however, it was found that if these guns were fired direct ahead or astern their blast rendered the sighting-hoods of the 13-inch guns untenable. To prevent this "interference," as it is called, the double-deck turrets were adopted. They constitute the most striking feature in these ships; nothing like it has ever been attempted before and it is not likely that it ever will be again. As far as the danger of interference is concerned, the device is likely to prove a success. The muzzles of the 8-inch guns project well beyond the sighting-hoods of the 13-inch gun turret below it, and no serious effects will probably be felt by the men stationed within them. It will be noticed, moreover, that the Kentucky will be able to bring the same number of 8-inch guns to bear in any direction as the Indiana, that is, two ahead or astern, and four on either beam; in fact, owing to the inability of the 8-inch guns of the Indiana to be fired dead ahead or dead astern, the four 8-inch guns of the Kentucky may be said to be more efficient than the eight similar guns on the Indiana. The great weight of two turrets and four guns with their ammunition is thus saved and can be put to other uses.

We have said that it is not likely that any more double-deck turrets will be built. The reason for this is the objection which naval designers feel to putting "too many eggs into one basket." It is an accepted axiom in warship design that the various gun stations of a ship should be as widely separated as possible, with a view to localizing the damage inflicted by a successful shot.

If the lower half of a double-deck turret should be crippled, the upper turret would also be placed *hors de combat*, and a light shell which was incapable of penetrating the 15-inch armor of the lower turret might pass through the 9-inch armor of the upper turret and wreck the turning gear below, thereby disabling the four guns. There is a further objection urged by the gunners in the fact that the two sets of guns must be trained together, whereas it might frequently be desirable in the course of a fight to train the 13-inch guns upon one part of the enemy and the lighter guns upon some other part. The whole question, however, was well thrashed out by the experts at the time the ships were designed, and it was considered that the economy in weight and machinery more than offset the objections which were raised against the system.

Next to the turrets the most novel feature in these ships is the powerful broadside battery of fourteen 5-inch rapid-fire guns which it has been possible to substitute for the four 8-inch guns and turrets and the four slow-firing 6-inch guns of the Indiana. This battery is ranged within a central battery on the main deck between the two turrets. There are seven guns on each broadside, each gun firing through an arc of 90 degrees. Though the shell for the 5-inch gun weighs only 50 pounds as against 250 pounds for the shell of the 8-inch gun, so great is the rapidity of fire from the former gun that three times the weight of metal will be thrown in a given time from the rapid-fire battery. The gunners will be protected by 6 inches of harveyized steel.

On the deck above will be another battery of twelve 6-pounder guns, and eight others will be located forward and aft on the berth deck. It will be the work of these guns to repel the attack of the torpedo-boats. A number of 1-pounders and Gatlings will be carried in the tops of the military masts.—*Scientific American.*

BOOK NOTICE.

ALL THE WORLD'S FIGHTING SHIPS, by Fred. T. Jane, published in this country by Little, Brown & Co., of Boston, will probably prove to be a valuable addition to naval literature. The book shows an endless amount of care in its preparation and is full of information. It contains descriptions and cuts of nearly all, if not all, of the fighting ships of the prominent nations. The cuts and data are admirably arranged for easy reference, and ships of all nations are classified according to their fighting and defensive power, into armored ships, of which there are five classes; then into eight classes of unarmored ships. The classification and arrangement are easy to understand and well suited to a book for general information. The data and descriptions are published in English, French, German and Italian. In the case of armored ships carrying vertical armor, small plans of the ships are given, showing the arrangement of the armor. For the whole work the author deserves great credit and the thanks of every one seeking information concerning the navies of the world.

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FEBRUARY. The Japanese Battle-ship Yashima. Natural Gas in the United States. Recent Improvements in Electro-galvanizing. Mechanical Stokers. Technical Education in Great Britain and Foreign Competition. Floating Docks. Recovering Tar and Ammonia from Blast Furnace Gases.

MARCH. The Building of a Ship. Can Coke be used as a Smokeless Fuel? The American Naval Officer of the Future.

ENGINEERING NEWS AND AMERICAN RAILWAY JOURNAL.

DECEMBER 23, 1897. The New Concrete and Steel Government Docks at Puerto Cabello, Venezuela. A New Sectional Gun.

DECEMBER 30. The Tidal Marshes of the Bay of Fundy.

JANUARY 6, 1898. The Eophone: a Device for Locating the Direction of Sound.

JANUARY 13. The Liverpool Docks.

JANUARY 27. Questions used in the Examination of Candidates for the Naval Civil Engineer Corps.

FEBRUARY 1. Boiler-testing with Various Fuels. The Alteration of Metals by Sea Water. The True Policy of the United States concerning the Nicaragua Canal.

FEBRUARY 24. The Diamond Shoal Lightship No. 69.

IRON AGE.

DECEMBER 23, 1897. The Delaware Shipyards. Heavy Machine Tools for the Armor Plant.

DECEMBER 30. Largest Drop Hammer in the World. The Armor Plate Matter.

JANUARY 6, 1898. The Armor Plate Plant. American Society of Naval Engineers.

JANUARY 13. British Shipbuilding in 1897. The Armor Plate Matter.

JANUARY 20. Oil Fuel Experiments on Hydraulic Lifeboat Queen.

JANUARY 27. The Canadian Nickel Industry. Influence of Mechanical Draft on Ultimate Efficiency of Steam Boilers.

FEBRUARY 3. The Chicago Shipbuilding Company's Machine Shop. The Illinois Steel Company. The Armor Plant Bids.

FEBRUARY 10. Oil Fuel Tests in Torpedo-boats. The Influence of the Great Siberian Railway upon Russian Industries. The Illinois Steel Company.

FEBRUARY 17. Small General Electric Motors. The Armor Plate Matter.

FEBRUARY 24. Forced Draft on Warships. Naval Matters in Washington.

MARCH 3. The Navy of the United States. Navy Matters at Washington.

MARCH 10. The Navy of Spain.

JOURNAL OF THE FRANKLIN INSTITUTE.

JANUARY, 1898. Geography of Precious Stones. A Photographic Impact Testing Machine for Measuring the varying Intensity of an Impulsive Force. Kryolith: its Mining, Preparation and Utilization.

MARCH. Tests of the Synchronograph on the Telegraph Lines of the British Government. The Severy Impression Process. Graphics of the Thermodynamic Function. Progress in Naval Architecture.

JOURNAL OF THE UNITED STATES ARTILLERY.

VOL. VIII., No. 3, No. 29. The Weldon Range-finder: its Use and Theory. Investigations on the Cause of Explosion of Shrapnel charged with High Explosives. A New General Ballistic Table. Professional Notes.

VOL. IX., No. 1, No. 29. Confederate Ordnance during the War. Howitzers and Mortars for Field Artillery, to Supply a Need of Curved Fire. National Defenses. History of the Seacoast Fortifications of the United States. IV. Old Fort Mantanzas. Ballistic Problems in Indirect and Curved Fire.

JOURNAL OF THE MILITARY SERVICE INSTITUTION.

JANUARY, 1898. Our Volunteer Army. The American Soldier. Officers on the Retired List. Military Department in Schools. Non-commissioned Officers. Military Notes.

MARCH. Hasty Intrenchments. The New Carbine. Instruction in First Aid. The Late Revolution in Colombia. Sowing without Reaping. Service School for Heavy Artillery. Reprints and Translations: 1. A Visit to the Ninth (French) Cuirassiers. 2. Aldershot Training in 1897. 3. Notes on Artillery. 4. Military Manœuvres of 1897. 5. The Armament of British Cavalry. 6. Coast Defense.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.

VOL. X., NO. 1, 1898. Steam Consumption of the Main and Auxiliary of the U. S. S. Minneapolis. Propulsive Power. Central Power Plants on board Ship vs. Distribution of Power. Water-tube Boilers. Trials of the Niclausse Safety Water-tube Boiler. Boiler-testing with Various Fuels. Speed of Construction, a Vital Factor of Naval Strength. The Diesel Motor. Speed and Power Trials of a Light-draught Steam Launch.

JOURNAL OF THE U. S. CAVALRY ASSOCIATION.

DECEMBER, 1897. Ranald Slidell Mackenzie. Military Policy and Institutions. The Military Geography of Mexico. The Fort Donelson Campaign. Scouting with Mackenzie. Reminiscences. Shall not our Legal Organization be Restored?

JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES.

JANUARY, 1898. Notes on Aluminum. Recent Designs in Steamship Construction upon the Great Lakes.

PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY.

DECEMBER, 1897. The Variation of Terrestrial Latitude. Some Results of the Norwegian Polar Expedition, 1893-96. Remarks on Polar Expedition.

SCIENTIFIC AMERICAN.

JANUARY 1, 1898. Coast and Harbor Mapping.

JANUARY 8. Lakes Submarine Wrecking Boat. Warships building in England. The Weather Bureau.

JANUARY 15. Dry Dock Construction. A Jet-propelled Lifeboat. Modern Conditions of Naval Warfare. The Combustion of Smokeless Powder.

JANUARY 29. Our New Battle-ships. Raising a Stranded Cruiser. A Great Electric Light Beacon. Naval Use of Homing Pigeons.

FEBRUARY 5. Japanese Cruiser Launched. Petroleum Fuel. Soap to Quiet Waves. Turbine for United States Torpedo-boats.

FEBRUARY 12. Gun Testing at Sandy Hook. Old Magazines. The Largest Steamship Companies.

FEBRUARY 19. McKinnon Boat-launching Device. Life-saving Davit Device.

FEBRUARY 26. The Battle-ship Maine. Cavalry in Future Wars. Gun Factory at Washington. Finishing Large Ordnance. Ship-bottom Paint. Weather Bureau Warnings.

MARCH 5. Industries of Japan. Measuring Heights reached by Balloons. Maine Inquiry. Reversing in Steam Turbines. Modern Torpedo Warfare.

MARCH 12. The Brooklyn Dry Dock. Fighting Forces of the World. Maine Wreck at Havana. Practice-ship Naval Cadets. The Spanish Army in Cuba.

SEABOARD.

JANUARY 6, 1898. New York's Shipping Record for 1897.

JANUARY 27. Launch of Japanese Cruisers.

THE ENGINEER (NEW YORK).

JANUARY 1, 1898. The Yarrow-Schlick-Tweedy System of Balancing Engines. Something about Screw Propellers. Practical Tempering of Steel.

JANUARY 15. Hult's Rotary Engine. Something about Screw Propellers. A Study of Boiler Types. A Broken Steam Pipe at Sea.

FEBRUARY 1. Portuguese Cruiser Adamastor. Pressures resulting from Changes of Velocity of Water in Pipes. Clearance and Compression in Steam Cylinders.

[FOREIGN.]

UNITED SERVICE GAZETTE.

DECEMBER 11, 1897. The Artillery of Japan. Sword-bayonets to be Sharpened. German and French Manœuvres. Recruits for the Fighting Service.

DECEMBER 18. Naval Expenditure and the Mercantile Marine. Engine-room Artificers and the Warrant Rank. Imperial Strategy.

DECEMBER 25. Wireless Telegraphy. Shipbuilding in the Royal Dockyards in 1897. The New Departures.

JANUARY 1, 1898. Monster Cannon. The Past and the Future. Trials of Torpedo-boat Destroyers. Report on some Gunshot Wounds received on the Northwest Frontier.

JANUARY 8. The French Navy. On the Selection of Strategic Objectives.

JANUARY 14. Mr. Balfour on National Defense. Foreign Policy and Sea Power.

JANUARY 22. The Federal Defense of Australia. The Vickers New 6-inch Gun. British Seamen for British Ships. Decadence of the Marine Forces.

JANUARY 29. Naval.

FEBRUARY 5. Surprise in War. Health of the Navy. Naval Needs.

FEBRUARY 12. Training of Merchant Seamen. Our New Cruisers.

FEBRUARY 19. Some Special Qualities of the British Fleet.

FEBRUARY 26. The Making of the Infantry Soldier. British Merchant Seamen. The Ethics of Warfare. The Maine Catastrophe.

JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.

DECEMBER, 1897. The French First-class Armored Cruiser Pothuau, 5365 tons, 10,000 I. H. P. The Future of the Torpedo. The Fourth Arm. Schulmeister the Spy. Java Campaign of 1811.

JANUARY, 1898. The New French First-class Battle-ship Charles Martel, 11,880 tons, 13,500 I. H. P. The Civil War in the United States. Discussion on the Military Prize Essay. The Old Royal Army of France. Soldiering in the West Indies in the Days of Queen Anne.

FEBRUARY. The Japanese First-class Battle-ship Yashima, 12,400 tons, 14,000 I. H. P. The Great Siege of Malta, 1565. The Federal Defense of Australia. The Fortifications of our Dockyards. Lines of Concentration of the German Armies towards the French Frontier. Broadside Submerged Torpedo Tubes.

PROCEEDINGS OF THE ROYAL ARTILLERY INSTITUTION.

JANUARY, 1898. The Services of Lieut.-Colonel Francis Dowman, R. A., in France, North America, and the West Indies between the years 1758 and 1784. British Gunners at the Siege and Battle of Narva in 1700. A Few Plain Remarks on the Positions and Work of the Artillery in the Field. Militia Field Artillery. Methods of Bringing Guns into Action.

ENGINEERING.

DECEMBER 17, 1897. Vickers Works at Sheffield. The American Society of Naval Architects and Marine Engineers. The Yarrow-Schlick-Tweedy System of Balancing Engines. Work in Peace and War. Torpedo-boat Destroyers.

DECEMBER 24. Vickers Works at Sheffield. The American Society of Naval Architects and Marine Engineers. Additions to the Navy in 1897. Armored Cupola for Fort Waelhem. Shipbuilding and Marine Engineering.

DECEMBER 31. Vickers Works at Sheffield. Shipbuilding and Marine Engineering in 1897. H. M. S. Fame. The French Navy. The Electric Lighting of H. M. Ships.

JANUARY 7, 1898. Messrs. Schneider and Co.'s Works, Creusot. Mudd's Marine Boiler. United States Naval Engineering.

The New Lighthouses on Lundy Island. Shipbuilding and Marine Engineering in 1897.

JANUARY 14. Messrs. Schneider and Co.'s Works, Creusot, II. Launch of a Warship in Japan. The Tropenas Steel-making Process. The Institution of Naval Architects. Shipbuilding Prospects.

JANUARY 21. The Shipping Industry in Japan. Messrs. Schneider and Co.'s Works, Creusot, No. III. Trial of H. M. S. Diadem. The Manufacture of Cordite.

JANUARY 28. Electric Generators. Messrs. Schneider and Co.'s Works, No. IV. The New Light Houses on Lundy Island. Traveling Gantry at Messrs. Harland and Wolff's Shipyard, Belfast. Executive Rank in the United States Navy. Trials of H. M. S. Diadem. The Russian Imperial Yacht Standart.

FEBRUARY 4. Electric Generators. Messrs. Schneider and Co.'s Works at Creusot, No. V. Trials of H. M. S. Diadem.

FEBRUARY 11. The Maxim Gun. Messrs. Schneider and Co.'s Works at Creusot, No. VI. Electric Generators.

FEBRUARY 18. Messrs. Schneider and Co.'s Works at Creusot, No. VII. The Spanish Cruiser Cristobal Colon. Trials of the Diadem. The United States Cruiser Maine.

FEBRUARY 25. Electric Generators. Messrs. Schneider and Co.'s Works at Creusot. The Maxim Gun, No. II.

MARCH 4. Messrs. Schneider and Co.'s Works at Creusot, No. IX. The North German Lloyd T. S. S. Kaiser Wilhelm der Grosse. Kynoch's Ammunition Works.

THE ENGINEER.

DECEMBER 17, 1897. The Mountings for Coast Artillery. The New Chinese Cruiser Hai Tien. Messrs. Laird Brothers' Work in 1897.

DECEMBER 24. High Explosives and Modern War Vessels. Note on some Warships' Steam Trials. Progress in Naval Ordnance in the United States. Schneider, Creusot, and Terni Plates. The New Docks at Portsmouth.

DECEMBER 31. The Condensation of Steam in Steam Engines and its Measurements, No. I. The War. United States Gunboats.

JANUARY 7, 1898. The Construction of Modern Wire-wound Ordnance. The Condensation of Steam in Steam Engines and its Measurements, No. II. Government vs. Private Manufacture of Armor Plate. The Portuguese Cruiser Adamastor. Shipbuilding in Belfast.

JANUARY 14. Cheap Electricity. Water Heat at Sea. Speed Trials and Experience in Commission of New Battle-ships of the United States Navy.

JANUARY 21. The Construction of Modern Wire-wound Ordnance, No. II. The Earliest Iron-built Ships. British Gunboats on the Niger. An Experimental Study of the Influence of Surface on the Performance of Screw Propellers.

JANUARY 28. Comparative Forces in Chinese Waters. The Haskin Process of Preserving Timber. A Traveling Gantry for Shipbuilding. The Birkenhead Destroyers. Torpedo-boat Design.

FEBRUARY 4. Squadrons now in Chinese Waters. The Construction of Modern Wire-wound Ordnance. The Bouncer Gun Accident. Coast Fortifications of the United States. H. M. S. Argonaut. Coaling Experiments at Portsmouth.

FEBRUARY 11. Modern Japan: Industrial and Scientific, No. XV. Schneider-Canet Quick-firing Mechanism. Dockyard Notes. The French Marine. H. M. S. Irresistible.

FEBRUARY 18. Shipbuilding in 1897. The Recent Strengthening of Hong-Kong. The Naval War Game. The Construction of Modern Wire-wound Ordnance, No. IV. A New Norwegian Warship. Schneider-Canet Quick-firing Ammunition.

FEBRUARY 25. French Naval Reforms. The Improvement of Plymouth Harbor. The Ballasting of Steamers.

INSTITUTION OF MECHANICAL ENGINEERS.

No. 1, 1897. Partially Immersed Screw Propellers for Canal Boats, and the Influence of Section of Waterway.

STEAMSHIP.

JANUARY, 1898. Shipbuilding Returns 1897. Donovan's Patent Stern Tube. Trials of another Roller Steamboat. The Building of the British Navy. The Clinker Filter. Working of Soft Steel for Boilers. Belleville Boilers. Fans for Marine Uses. Battle-ships of the New U. S. Navy. Mechanical Efficiencies of Marine Engines. Trimming Tanks.

FEBRUARY. Von Essen's Patent Boiler Tube Cleaner. American Shipbuilding. Defects in Propeller Shafts. Ship's Measurements in Germany and Great Britain. Shipbuilding at Home and Abroad in 1897. Launch of H. M. S. Argonaut. The Ventilation of Steamships. Modern Steamboat Engines.

MARINE RUNDSCHAU.

FEBRUARY, 1898. Determination of Latitude and Longitude in Cloudy Weather and at other Times. Opinions on the Economic Advantages of High Steam Pressures in Engine-driv-

ing. Explosion under Water. The New "Kaiserhofen" in Bremen. Speed Revolutions of Marine Engines. Naval Notes.

MARCH. Strategic View of the Mediterranean. Contributions to Nautical Astronomy. Electric Steering Engines. Tests of Metals for Tensile Strength and Elongation. Work done in the Imperial Physical Laboratory (spring, 1895, to the summer of 1897). Trials of the Aegir. Kiaotshau. The Occupation of Tshingtau. The German Fleet as viewed from an Oldenburg Standpoint. Naval Notes.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

VOL. XXVI., No. 2. Statistics on the Growth of the Fleets of Six European Powers. Progress in Armor and Ordnance during 1896. Germany's Programme for Increasing the Fleet. Foreign Naval Notes.

ANNALEN DER HYDROGRAPHIE UND MARITIMEN METEOROLOGIE.

No. 11, 1897. Hydrographic Reports from the South Pacific. The Comparison between Steamship and Sailing-ship Traffic. Some Points on Thermometers. Determination of Deviation of Compass in Thick Weather. On the Unreliability of Fog-signals on High Coasts. Currents on the Newfoundland Banks. Electric Illumination of Compasses on board Ship.

No. 12. Temperature Observations of Coal Cargo of Bark Madeleine Rickmers on Voyage to East Indies. Typhoon Notes. On Pendulum Observations. Hydrography of Gulf of St. Lawrence. New Storm Signal System on the China Coast. Bottle Posts.

1898, No. 1. Reports on Earthquake Disturbances noted at Sea. Remarkable Storms. Results of Magnetic Observations compared with Theory. Pilot and Towing Charges in Antwerp. Darwin's Theory of Coral Growth.

LE YACHT.

No. 1031, DECEMBER 11, 1897. Speed of Fighting Ships.

M. A. Normand, the eminent engineer, published some time ago an interesting pamphlet with the above title. It brought forth comments from the pens of authorized men like Emile Duboc and Naval Constructor V. G. The letter in this number is an answer to their criticisms and a vindication of M. Normand's theory.

No. 1032, DECEMBER 18. The Naval School on Shore.

Following the examples of England and the United States, a plea is set forth advocating the transfer to land of the school of the Borda from its present position in the roads of Brest.

No. 1033, DECEMBER 25. Re-establishment of the Rank of "Capitaine de Corvette" (lieut.-commander) and Advancement in the Navy.

No. 1035, JANUARY 8, 1898. The Navy and its Rôle in Time of Peace.

No. 1036, JANUARY 15. The War Navies in 1897. Fine Display of Seamanship by our Officers. The Centre-board as a Practice Boat. Conditions of Life on board Men-of-war.

No. 1038, JANUARY 29. The Crisis in the Question of Advancement in the Navy.

No. 1039, FEBRUARY 5. The Navy in Parliament. More about the Rank of Capitaine de Corvette.

No. 1040, FEBRUARY 12. Measurement Formulas for Yachts and Monotypes. The Second-class Armored Battle-ship Alexandra. Tide Signals on the Coasts of France.

No. 1041, FEBRUARY 19. Advancement in the Navy.

In order to obviate in a certain measure the evil of stagnation in the navy, it is proposed (1) to re-establish the rank of capitaine de corvette, (2) to reduce the limit of the age of retirement from 60 to 58 for captains and from 58 to 55 for commanders, (3) to compel the retirement of a certain number of officers, (4) to form a skeleton of fixed residences, meaning a body of officers not in the line of promotion. Some kind of reform has become urgent, owing to an alarming increase of resignations in the navy, 50 during the last three years, according to departmental statistics. J. L.

REVUE DU CERCLE MILITAIRE.

No. 48, NOVEMBER 27, 1897. Protection of the Coasts and Provisioning of Paris. Employment of Bicyclists in Russia. Actual State of the English Army (cont.).

No. 49, DECEMBER 4. The Army and Navy Universal Exposition in 1900 (cont.). A Note on the Penetration of the Italian Rifle Model of 1891. Actual State of the English Army (cont.).

No. 50, DECEMBER 11, AND No. 51, DECEMBER 18. The Army and Navy Exposition in 1900. Military Situation of Russia as it is and as it should be, etc.

No. 1, JANUARY 1, 1898. The Influence of Number in War.

With this number the Review inaugurates a series of practical military problems to be worked out on special maps. This plan has been conceived for the purpose of putting into actual practice, on paper, the regulations and instructions concerning service in the field. The Review propounds a theme elaborated by a group of officers, with data for a practical solution of the problem, of which a typical solution is given in a subsequent number, permitting a comparison with each officer's individual work.

No. 3, JANUARY 15. A Visit to the Barracks of a French Regiment of Cavalry.

No. 6, FEBRUARY 5. The Combat (a lecture delivered by Lieut.-Colonel Paquin).

No. 7, FEBRUARY 12. Solution of the First Problem: "Service de sûreté en station" (outpost duty).

No. 8, FEBRUARY 19. Attack of the various Means of Supply of an Army Corps by Cavalry during Battle. The Combat (cont.).

No. 9, FEBRUARY 26. Examinations for Admission to the Superior School of War for 1898; a Solution to the "Military Question," with Maps.

LE MONITEUR DE LA FLOTTE.

No. 49, DECEMBER 4, 1897. Reorganization of the Corps of Naval Inspectors.

No. 50, DECEMBER 11. A Cruiser Yacht for the President of the French Republic. The Navy in Parliament.

No. 51, DECEMBER 18. The Re-establishment of the Rank of "Capitaine de Corvette" (lieut.-commander). The Navy in Parliament. For the Security of Navigation.

No. 52, DECEMBER 25. The Mail Service between New York and Hâvre.

No. 1, JANUARY 1, 1898. Neutralization of the Banks of Newfoundland.

No. 2, JANUARY 8. The Cry for more Cruisers.

No. 3, JANUARY 15. The Hourst Mission in Africa. The Navy Estimates.

No. 4, JANUARY 22. The Navy of Japan.

No. 5, JANUARY 29. The Colonial Army. Battle-ships and Cruisers.

No. 7, FEBRUARY 12. What is our Navy for?

This is an answer to several criticisms published in newspapers and in pamphlet form in regard to the services expected from the navy.

No. 8, FEBRUARY 19. Advancement in the Navy. Loss of the Torpedo-boat 133. J. L.

REVUE MARITIME.

NOVEMBER, 1897. Geometry of Diagrams (cont.). Artificial Ventilation studied at the Point of View of its Application to the Destroyer Condor. Circulation of Water in Multitubular Boilers. Searching the Enemy at Sea. Recognition of Belligerents considered in its Bearings to Naval Warfare. Foreign Navies.

DECEMBER. Sixth Contribution to the Geometry of Naval Tactics. Development of War Navies during the Last Decade. A Noiseless Siphon (Exhaust) for Steam Launches. Foreign Navies: Questions of Naval Tactics, by the Russian Vice-Admiral Makaroff.

JANUARY, 1898. A Register to Check Waste Power in Engines: Commandant Baill's Method. A Study of the Hemp and Flax for the Manufacture of Canvas in use in the Navy. An Essay on Phonetic Signals to prevent Collisions at Sea in Thick Weather. An Electric Contrivance to Signal from the Bridge the Direction of the Rotation and the Number of Turns of the Screw. Foreign Navies: Duties of Torpedo-boats, their Stations, and Reconnoitering Signals (trans. from the Italian). J. L.

RIVISTA DI ARTIGLIERIA E GENIO.

NOVEMBER, 1897. Horsemanship of the Field Artillery Recruit. A Study of the Probability of Fire in Coast and Ship Batteries. Characteristics of the Fire of Coast Batteries. The Phenomenon of Vision in connection with the Pointing of the Piece.

DECEMBER. Secondary Ballistic Tables. Lightning Conductors and the New Temporary Way of placing them upon Military Buildings.

JANUARY, 1898. The Supplementary Parameters in Rational Ballistics. Building War Observatories out of Bridge Materials. A Method for Correcting Defects in the Conduct of Coast Battery Fire (with diagram). A Folding Support in the School of Fire of the Russian Infantry. J. L.

RIVISTA MARITTIMA.

DECEMBER, 1897. On Naval Battles. The Proposed Commercial Treaty between the United States and Italy.

JANUARY, 1898. Our Navy Crews. The Speed of Warships. Fourth Contribution to the Naval Kinematics. The State of the Italian Merchant Marine.

FEBRUARY. The Silurus: a Notice on its Speed, its Radius of Action, and on its Destructive Power. The Equipment of the Navy. J. L.

REVISTA TECNOLOGICO-INDUSTRIAL.

OCTOBER, 1897. Railways of Secondary Importance. Considerations on the Distribution of a System of Forces among an additional Number of Props.

NOVEMBER. Railways of Secondary Importance (cont.). Substitution of the Cable System to the Trolley in the System of Tramways in Barcelona. Considerations on the Distribution of, etc.

DECEMBER. Public Lectures of the Society "Tecnológico-Industrial." J. L.

BOLETIN DEL CENTRO NAVAL.

AUGUST-SEPTEMBER, 1897. The Dockyard: its Meaning and its Use. A Plan for Lighting the Coasts of the Argentine Republic. Questions on Naval Strategy.

NOVEMBER. Modern Destroyers. Notes on Ship and Squadron Training. The Next Naval War.

MORSKOI SBORNIK.

No. 9, SEPTEMBER, 1897. The Significance of Sea Power in the History of Nations. English Naval Budget, 1897-8. Turbine Steam Engines. The Launching of Ships. The Preparation of Tables of Deviation of the Compass. The Gyroscopic Horizon (Admiral Fleuriais' System).

Naval Chronicle: Shipbuilding Abroad. Accidents to Ships: Collision of Cruiser Phaeton and Torpedo-boat Thrasher. Ordnance: Sims-Dudley Pneumatic Gun. The Krupp System of Sights with Level. Coast Defense: Protection of the Ports of the South Coast of Great Britain from Torpedo Attacks.

No. 10, OCTOBER. Opinions upon Questions in Naval Tactics. Fleet Organization of the Future. Value of Ordnance in Various Battle Formations. Development of the Mathematical Theory of Shipbuilding from the Time of the Founding of the British Institute of Constructing Engineers. Notes on Ships' Boilers. The Ship-trawl. Navigation Notes.

Naval Chronicle: Shipbuilding Abroad. Accidents to Ships: The Grounding of the English Torpedo Destroyers Thrasher and Lynx. Explosion of Torpedo on board the German Iron-clad Friedrich Karl. Loss of German Torpedo-boat S 267. Ordnance Trials of Hadfield Shells.

No. 11, NOVEMBER. Problems in Naval Strategy. The Blockade of Coasts. The Fighting Value of Ships' Artillery. The Use of Naphtha for Steam Boilers of Warships. Wooden Sheathing of Steel Ships. Metallurgical Notes. Two Years in Australian Waters.

Naval Chronicle: Shipbuilding Abroad. Ordnance: Spanish Obturating Electric Primer, Model 1896.

No. 1, JANUARY, 1898. Historical Sketch of the Russian Marine Infantry. Comparative Strength of the Fleets of the Principal Naval Powers. Ironclads of To-day and of the Future. Ordnance Notes. Recent Improvements in Yarrow and Belleville Boilers. Fifty Years' Existence of the Morskoi Sbornik (1848-1898).

Naval Chronicle: Shipbuilding Abroad. Accidents to Ships: Loss of the Japanese Ironclad Fu-So.

REVIEWERS AND TRANSLATORS.

Lieut.-Comdr. R. R. INGERSOLL, U. S. N.
Lieutenant J. B. BERNADOU, U. S. N.
Professor JULES LEROUX.
Lieutenant H. G. DRESEL, U. S. N.

ANNUAL REPORT OF THE SEC. AND TREAS. OF THE U. S. NAVAL INSTITUTE.

To the Officers and Members of the Institute:

Gentlemen:—I have the honor to submit the following report for the year ending December 31, 1897.

ITEMIZED CASH STATEMENT.

Receipts during Year 1897.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Dues	$536 08	$190 83	$388 70	$466 65	$1582 06
Subscriptions	159 71	217 89	147 25	144 30	669 15
Sales	124 25	129 00	37 91	22 47	313 63
Interest on Bonds	208 90	9 00	57 36	9 00	284 26
Advertisements	126 25	20 00	215 00	135 00	496 25
Binding	8 00	5 45	5 00	11 80	30 25
Check on deposits	. . .	20 00	. . .	. . .	20 00
Totals	$1163 19	$592 17	$851 22	$789 02	$3395 60

Expenditures during Year 1897.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Printing	$316 03	$408 29	$464 15	$368 41	$1556 88
Salaries	300 00	300 00	300 00	300 00	1200 00
Postage	36 35	30 52	35 67	38 97	141 51
Expressage	5 81	1 70	2 90	2 50	12 91
Freight and hauling	3 92	5 46	12 38	3 07	24 83
Binding	41 10	. .	80	. . .	41 90
Stationery	1 63	37 75	20	15 03	54 61
Office expenses	1 00	1 25	. . .	1 25	3 50
Telegrams and telephone	75	29	25	. . .	1 29
Prize	100 00	. . .	. . .	. . .	100 00
Gold Medal and engraving same	17 00	. . .	. . .	. . .	17 00
Insurance and rent on safe deposit box	5 00	6 30	. . .	. . .	11 30
Purchase back Nos.	. . .	. . .	. . .	3 00	3 00
Cashing check on deposits	. . .	20 00	. . .	. . .	20 00
Totals	$828 59	$811 56	$816 35	$732 23	$3188 73

SUMMARY.

Balance of cash unexpended January 1, 1897	$4241 41
Total receipts for 1897	3395 60
Total available cash, 1897	$7637 01
Total expenditures, 1897	3188 73
Cash unexpended January 1, 1898	$4448 28
Cash held to credit of reserve fund	59 14
True balance on hand January 1, 1898	$4389 14
Bills receivable for dues, 1897	857 89
" " " back dues	950 50
" " " binding	15 00
" " " subscriptions	11 45
" " " sales	80
" " " advertisements	187 50
Value of back numbers (estimated)	2000 00
" " Institute property	100 00
	$8512 28

RESERVE FUND.

United States 4 per cent. Consols, registered	$900 00
District of Columbia 3.65 per cent. registered bonds	2000 00
" " coupon bonds	650 00
	$3550 00
Cash in bank uninvested	59 14
	$3609 14

MEMBERSHIP.

The membership to date, January 1, 1898, is as follows: Honorary members, 5; life members, 108; regular members, 566; associate members, 198; total number of members, 876.

During the year 1897 the Institute lost by death and resignations 31 members. 33 new members' names were added to the rolls—19 regular, 14 associate; 1 life member; 1 regular member became a life member—the prize essayist.

MEMBERS DECEASED SINCE LAST REPORT.

Braine, D. L., Rear-Admiral, January 30, 1898.
Worden, John L., Rear-Admiral, October 18, 1897.
Lee, S. P., Rear-Admiral, June 5, 1897.
Calhoun, G. A., Lieutenant, U. S. Navy, April 28, 1897.
Jenkins, F. W., Lieutenant, U. S. Navy, February 15, 1898.
Breckinridge, J. C., Ensign, U. S. Navy, February 11, 1898.

The Institute had on hand at the end of the year the following copies of back numbers of its Proceedings:

Whole No.	Plain.	Bound.	Whole No.	Plain.	Bound.
1	110	....	43	168	3
2	241	....	44	60	10
3	51	....	45	42	18
4	140	....	46	49	19
5	118	....	47	31	18
6	1	....	48	50	18
7	1	....	49	18	17
8	31	....	50	62	17
9	35	....	51	35	18
10	1	....	52	55	17
11	211	....	53	160	34
12	50	....	54	3	4
13	1	....	55	55	17
14	2	....	56	457	51
15		....	57	8	12
16	225	....	58	2	7
17		....	59	15	16
18	105	....	60	1	1
19		....	61	190	18
20	126	1	62	140	16
21	222	1	63	77	6
22	260	1	64	30	18
23	177	1	65	124	18
24	187	1	66	15	16
25	1040	40	67	9	15
26	212	90	68	150	9
27	300	27	69	156	16
28	2	15	70	98	17
29	208	9	71	26	16
30	300	27	72	237	19
31	35	50	73	230	19
32	17	173	74	332	19
33	10	162	75	227	19
34	1	1	76	228	19
35	139	5	77	225	18
36	278	29	78	210	18
37	200	24	79	229	18
38	248	1	80	234	18
39	235	1	81	308	18
40	37	115	82	305	18
41	259	19	83	303	18
42	108	19	84	213	18

1 Vol. X., Part 1, bound in half morocco.

Very respectfully,

H. G. DRESEL,

Lieutenant, U. S. Navy, Secretary and Treasurer.

OFFICERS OF THE INSTITUTE.

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Lieutenant GEORGE F. COOPER, U. S. Navy (ex-officio).

SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1899.

A prize of one hundred dollars, with a gold medal, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1899. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

5. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

6. All essays submitted must be either type-written or copied in a clear and legible hand.

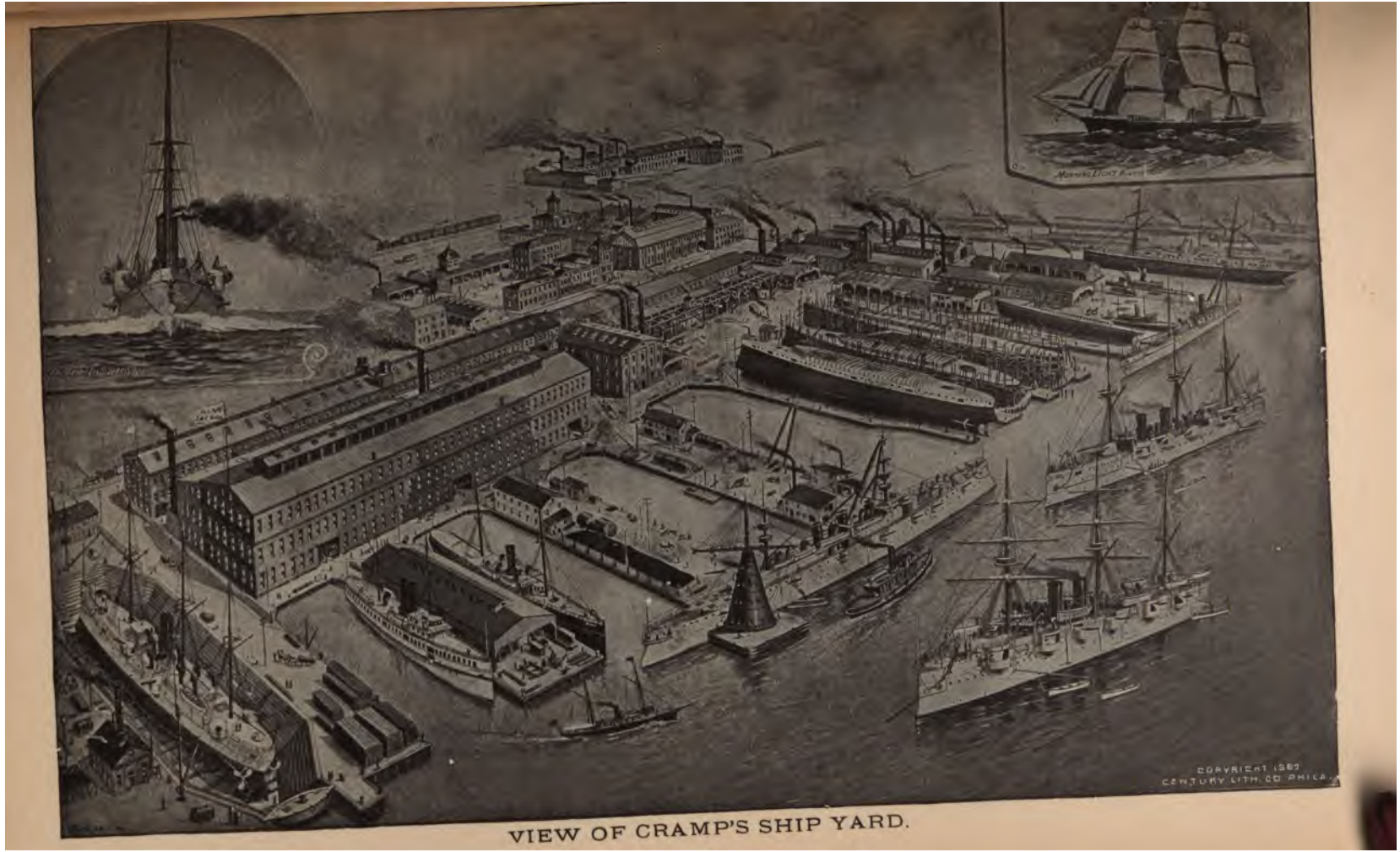
7. The successful competitor will be made a Life Member of the Institute.

8. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of the Board of Control.

H. G. DRESEL,
Lieut., U. S. N., Secretary and Treasurer.

ANNAPOLIS, MD., *January 1, 1898.*



VIEW OF CRAMP'S SHIP YARD.

Vol. XXIV., No. 1. March, 1898. Whole No. 85.

PROCEEDINGS

OF THE

UNITED STATES

NAVAL INSTITUTE.

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ANNAPOLIS, MD.

Entered at the Post Office at Annapolis, Maryland, as Second Class Matter.

A Warning to Users of Alum Baking Powders.

CASES OF POISONING IN INDIANA.

The following appeared in the Logansport, Indiana, *Times*:—

Dr. Souder was summoned by telegraph last Sunday night to attend the family of Braden Harper, living southwest of Logansport. Four of the family were poisoned from eating dumplings. The father and one child, who had not partaken of the dumplings, were well, while the mother and three children were in a serious condition. It is probable that had not vomiting ensued, emptying the stomach, the four would have died from the effects. It is supposed the poison was caused from the baking powder used in making the dumplings. The wife probably added a larger amount than she usually did, which in the greater quantity proved a noxious poison. The baking powder used was branded the * * * *, manufactured by the * * * *. This should be a warning in using cheap baking powders, which flood the country. People buy them because they are cheap, and the merchant buys them because he can sell them for a profit. In many stores one can not purchase a standard brand. You have to purchase the cheap stuff or do without. We are of the opinion that most of the prize baking powders belong to this class.

The highest authorities in chemical science pronounce alum injurious to health and a destroyer of digestion.

Here is explicit evidence that it is a noxious poison.

Alum baking powders likewise coagulate the blood rapidly, interfering with its ready course through the arteries and valves of the heart, predisposing to heart-failure.

Alum baking powders are forbidden from sale by law in Minnesota and Wisconsin, unless they are branded as a warning to consumers.

By the laws of England it is a crime to put alum in bread in any form.

NOTE. The Royal Baking Powder Co. publish the above facts because they are facts of great importance, and to say that while alum baking powders are sold cheap, they have little strength, and are dear at half price, to say nothing of their effect upon the health, and the bitter taste they impart to the food.

The Royal Baking Powder is far above question as regards its quality and healthfulness, because it is made of cream of tartar derived only from grapes. No other article has ever received such high praise for its quality.

Consumers may use the Royal with full assurance that they not only get the worth of their money, but that they also get the best cream of tartar baking powder that can be had.

ROYAL BAKING POWDER CO., NEW YORK.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twenty-sixth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life membership fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.